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ABSTRACT

An introduction to the use of computers for educational administrative purposes is offered in this book, which presents basic systems methodologies which can be used for selecting and designing computer applications. Traditional systems analysis techniques are used to illustrate the design of microcomputer applications at the school and district level, specifically, to identify needs and design a strategy to meet those needs. Following an introductory chapter, chapter 2 defines the concept of a "systems study." A systems approach to goal achievement is advocated to help school managers maintain control in increasingly complex school systems. The following chapters offer detailed discussions of the steps involved in a good systems analysis, such as preliminary, input and output, and processing analyses; alternatives and applications; selection and design; implementation and management; and administrative issues and strategies. A selected list of 48 readings on instructional and administrative computing is offered. Appendices contain directories and descriptions of selective educational administrative software systems and other software cited in the text. (LMI)

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Administrative Uses of Microcomputers in Schools

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A SYSTEMS ANALYSIS APPROACH TO SELECTING, DESIGNING AND IMPLEMENTING AUTOMATED *systems*

Edward John Kazlauskas, Ph.D.
&
Lawrence O. Picus, Ph.D.

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ADMINISTRATIVE USES OF MICROCOMPUTERS IN SCHOOLS

A Systems Analysis Approach to Selecting, Designing, and Implementing Automated Systems

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To my family, friends and dependable home computer— EJK

To Susan,
Who has helped me learn to talk about computers in plain English — LP

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Foreword

This book is intended as an introduction to the use of computers for administrative purposes in schools. It is an outgrowth of a course offering at the University of Southern California, School of Education, on the administrative uses of computers and data processing. Because there are a large number of publications that deal with instructional use of computers in schools, this topic is not considered here. Likewise, we do not repeat the material available in the many publications that deal with computer hardware and software fundamentals. Finally, we assume that the reader is familiar with basic computer terminology and concepts, or can locate a source for review of these topics.

The book will introduce basic systems methodologies which you can use to select and design computer applications, with particular emphasis on microcomputers. You can also use this book to develop a detailed understanding of application needs before you purchase a computer package for specific administrative functions such as student record keeping, class scheduling, personnel records, or business operations.

In addition to its use in college courses on administrative computing in educational settings, this book is intended to serve as a guide to school business administrators faced with implementing an automated computer system. It provides a framework that administrators whose responsibility includes the data processing department can use to organize their decision making process. At the same time, managers of data processing departments within school districts will find the material presented here useful in terms of structuring the actual procurement of a software/hardware system designed to fulfill a specific school business need.

We have attempted to stay away from discussions of specific software products or hardware platforms as much as possible, choosing instead to refer to generic applications and systems. In the rapidly changing world of microcomputing, it is impossible to publish a book on computer hardware that is not obsolete before it is printed. However, it is impossible to discuss the processes or procedures used to determine user needs and procure a system without mentioning specific products occasionally. Our emphasis ,however, remains on the use of a system study to identify needs and design a strategy to meet those needs. This discussion should remain independent of specific software and hardware issues. However, to make the book as useful and practical as possible we have included in an appendix a selective list and description of current educational administrative software/systems.

The text is organized to allow a logical progression from elementary systems concepts to the development of a composite of various systems analysis skills. By the end of the book, you should be able to apply systems analysis to the selection and design of school-specific computer applications. Although specific hardware and software examples are provided throughout the text, our approach is relevant to any situation since it provides a framework for examining computer options independent of technological change.

Throughout the book we use traditional systems analysis techniques to illustrate the design of microcomputer applications at the school and district level. These examples include both in-school computer development using application software, such as a spreadsheet or database manager, and procurement of commercially available, "off-the-shelf" systems. Although the application examples in the book are primarily from a small setting, the applications are easily transferable to larger environments.

Following an introductory chapter, Chapter 2 defines the concept of a "systems study." It suggests that as systems, schools have become more complex and new tools are needed to help managers maintain control. A systems approach to accomplishing a goal or set of goals is postulated. The following chapters provide detailed discussions of the steps involved in a good systems analysis. By using these basic tools, a school administrator will be able to analyze his or her school district's needs, and make good decisions about how computers can be used to assist with complex management tasks. At the end of the book there is a Selected List of Readings on Instructional and Administrative Computing. There are also two Appendices which provide: a directory; and description of educational administrative software, and a directory of software packages which are cited in this book or which can be used to assist in conducting a systems analysis.

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CHAPTER 1
Introduction

Today, computers pervade our society, and are used in all types of organizations. The educational sector is no exception. Since the 1960s there have been developments in the educational use of computers both for instructional and administrative purposes.

Instructional Computing

Instructional computing can be traced back to the 1960s with the development of programs designed to operate on mainframe computing systems. A prime example is PLATO, one of the first computer-assisted instruction (CAI) and computer-managed-instruction (CMI) programs. PLATO's computer terminals brought instructional computing into individual classrooms, laboratories, and library/media centers. Other important instructional computing developments include:

- Introduction of TICCIT, a minicomputer-based system
- Development of LOGO, a problem-solving computer language directed towards children
- Utilization of higher-level languages, such as BASIC for developing instructional applications
- Development of authoring languages specifically designed to assist in courseware development

The proliferation of inexpensive microcomputers, especially the Apple II, in the late 1970s brought CAI to many schools. Today, we see continued growth in the use of microcomputers for instructional purposes.

Thousands of instructional software packages are available for a wide array of hardware. These courseware packages include programs like Math Blaster, Oregon Trail, and Designasaurus. They provide easily used instruction on a wide range of subject matters. The programs use a variety of instructional methods, including drill and practice, tutorial, and simulations.

More recently, general-purpose software, such as word processing and database management packages, have been integrated into the curriculum in such areas as composition and American history. Computers are also used as instructional tools. Examples include using them as calculators or to access the vast quantity of information available outside of the traditional

school site in bibliographic databases. Indeed, teachers and administrators have been inundated with a wide array of instructional computing packages all aimed at the educational setting.Today many educators accept the computer as an essential instructional tool. CAI is viewed as a way to supplement and improve instruction, as a cost-effective alternative to other instructional delivery methods, and as having the potential to inaugurate school innovation.

Data from several sources show how pervasive computers have become in United States schools. A survey conducted in 1986 found 85 percent of U.S. elementary schools and 97 percent of the high schools had at least 1 microcomputer. It calculated the median number of computers at elementary schools to be 6, and the median number at the high schools to be 21 (Becker, 1986). Another 1986 report, this one by Quality Education Data (QED), found 750,000 personal computers in schools (Ploch, 1986). In recent years, this number has increased dramatically. The U.S. Office of Technology Assessment estimates that in 1988 there were over 2,000,000 computers in U.S. schools, an average of one computer for every 30 students (U.S. Office of Technology Assessment, 1988).

The large number of microcomputers (and the use of other, larger computers) in the schools attests to their wide acceptance for instructional purposes. This rapid infusion of technology has created a number of important issues that must still be resolved. These include:

- The need for teacher and administrative in-service training in the application and use of computers
- The budgetary implications of computerization on other school programs
- The need to emphasize learning rather than simply focusing on computer technology
- The need to strengthen the actual integration of computers into the curriculum

Even with these caveats, the bottom-line on instructional computing is that computers have become a major component in the instructional delivery process.

Administrative Computing

Computer use in school administration has also experienced dramatic growth in recent years. Administrative development has occurred at the school level, the district office level, and at state departments of education. As with instructional computing, early administrative uses relied on mainframe or minicomputers accessed through remote terminals. Districts either purchased their own computer systems or contracted with outside service bureaus for applications such as scheduling, student record keeping, payroll and accounting.

The use of large-scale computing is still common in many schools and school districts. But, just like instructional areas, microcomputers have had

a major impact on the way school districts conduct business. In many instances, microcomputers have become a realistic alternative to large mainframe computers as a means of distributing data processing tasks, and as a basis for computer networks. A 1988 article in *InfoWorld* describes the advantages one school district realized when it switched from a mainframe system to 17 local area networks (LANs). The advantages included inexpensive solutions to a number of technical problems the district was having with the mainframe system, and faster response time for end users. Most importantly, the relatively low price of today's microcomputer hardware and software (along with its increased power and capabilities) have made computer technology available to the smallest district and to individual school sites.

The computer is a powerful tool to help operate and manage our schools. Its potential administrative uses include:

- Helping instructional leaders work with teachers to increase their effectiveness and productivity
- Simplifying the budgeting process by making "what-if" questions easier to ask
- Improving student support services
- Reducing or stabilizing program costs by making analytic tools easily available to administrators
- Helping route and dispatch school buses
- Analyzing the effects of redrawn school attendance boundaries on individual school enrollments and ethnic mix
- Assisting school administrators in making complex decisions
- Helping school boards in their policy deliberations

While there are many other administrative uses of computers, they can also impact the human components of the teaching-learning process, including students, teachers, support staff, administrators, the school board, and parents. Our enthusiastic endorsement of the use of computers in schools does not mean implementation of this technology is easy, or that there have not been failures in the past. But the successes are exciting and the future potential of computers in education and school administration is very high.

The administrative use of computers in schools has received growing attention in recent years. Session topics and workshops at professional association meetings and articles in education journals attest to this. There is keen interest in outlining the competencies school administrators need to successfully implement and operate an administrative computing system. A study published in the International Council for Computer's *Education Bulletin* (1984, January), identified an initial set of 35 computer competencies for school administrators.

While many of the competencies focus on computer literacy and instruction, several deal specifically with administrative tasks:

- Identifying tasks for computerization
- Planning an educational data processing application

- Evaluating and selecting software
- Evaluating and assessing hardware configurations
- Awareness of the ways computers can help decision making
- The ability to locate information on funding sources for hardware and software designed for administrative computing

Our Approach

The school administrator is responsible for selecting the correct application for computerization, designing the appropriate system based on a specific hardware and software choice, and implementing this choice in the most cost-effective manner. This is not easy to accomplish. However, by following a logical approach to computer selection, design and implementation, the school administrator can ease the task.

The chapters that follow present information on the systems approach. While use of this system will not guarantee successful acquisition installation and operation of a computerized system to meet a predefined need, it will provide administrators with an analytic framework which will improve the chances of success.

CHAPTER 2
The Systems Study

What is a system? A system can be considered a group of interdependent elements working together to accomplish a predetermined purpose. In this context many things can be thought of as systems, including a city, the environment, a human body, a business or industrial enterprise, a library, or a school. The term "system" is all-pervasive and can refer to biological, physical, and social organisms. For this book's purpose, the systems view has a management and technology orientation. Specifically, we are interested in systems in the context of computer use in the schools.

Historical Development

Organizations have become increasingly complex over time. Just view the organizational structure, the data processing needs, the services provided, and the technologies used in today's schools compared to schools of 100, 50 or even 25 years ago. The complexity that has evolved in schools has occurred in all other organizations as well. To help managers deal with this complexity, a number of techniques, primarily quantitative and descriptive in nature, have been developed. (See the Bibliography for readings describing these techniques.) Many of these tools, such as time and motion studies and cost accounting, have been adopted by business and industry to help solve operating problems.

The introduction of computers into organizations made the use of these tools more efficient and increased individual work capacities and productivity. Computers also created additional complexity in the workplace. The computer is not always the answer to dealing with a problem. Other options such as a micrographics system or the redesign of a manual system may be more appropriate. Managers realized that systems analysis techniques could be used to integrate computers into an organization efficiently and effectively. Organizations, such as schools, have turned to the use of systems analysis to help them implement new computer applications.

The School System

We stated previously that a system is a group of interdependent elements acting together to accomplish a pre-determined purpose. A school is a system consisting of interdependent subsystems, including:

Figure 2.1
The School System

- An administrative subsystem
- An instructional subsystem
- A plant operation subsystem
- A transportation service subsystem
- A food service subsystem
- A co-curricular subsystem
- A health service subsystem, and
- Possibly other subsystems depending on the individual circumstances of the school district.

Each of these subsystems is composed of groups of interdependent elements which could be further subdivided into smaller elements or modules. For example, the administrative subsystem would include a student services module which, in turn, could be divided into scheduling, grade reporting, and attendance modules (See Figure 2.1).

Systems Analysis

To accomplish its purpose, the components of the system or subsystem, and the activities associated with those components, can be structured in a variety of ways. The role of systems analysis is to design the most feasible, suitable, and acceptable structure. This structure may be a manual system or a sophisticated computer-based system—the systems analyst is not limited to a specific design option. Instead, the entire spectrum of options is available for consideration.

Systems analysis refers to the use of management techniques to accomplish the system design. A person using systems analysis needs to have the technical capability to analyze a problem which is done by examining its parts. The analyst takes a system apart, examines it, and puts it back together again. Through this process the analyst understands what is going on, and through this understanding can design a new system if needed.

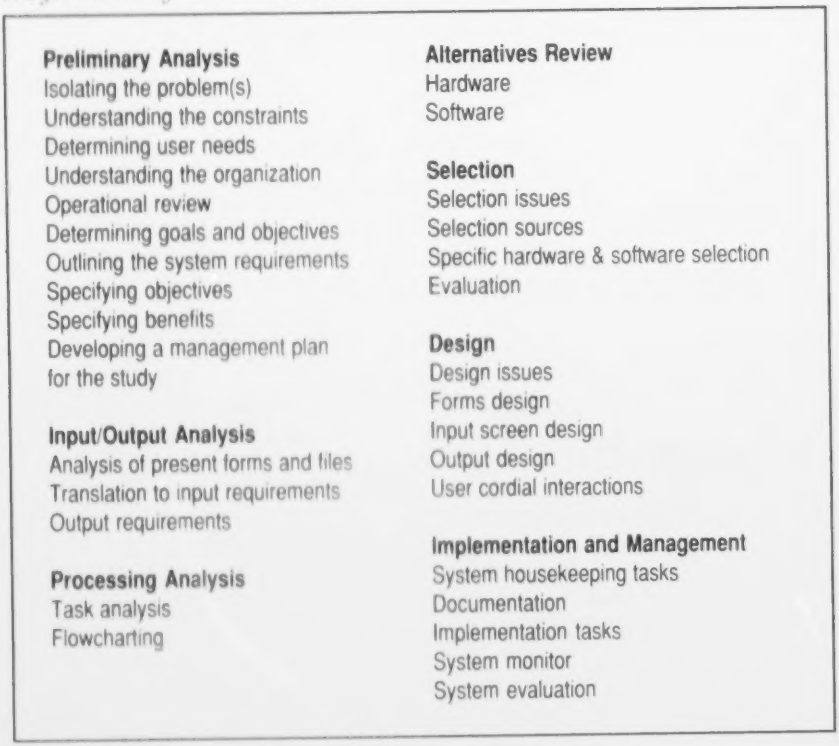
The Systems Analysis Model

There are many guides, or models, which can be used to determine the best structure, the best way to accomplish a goal, or the best way to resolve a problem. These models provide the framework needed to conduct a systems analysis study. A seven-step version of the systems analysis process is shown in Figure 2.2.

It is important to note that a *Total Systems Study* model is not provided in the figure. Missing from the model are the evaluation and cost-effectiveness phases associated with examining non-computer system alternatives. It is assumed that the computer is the option. But, remember, a new or redesigned manual system may be the more cost-effective solution. Similarly, some of the specific tasks associated with each step in our model are computer specific.

Each of these steps are discussed in the following seven chapters. Each chapter includes examples of systems analysis methodologies applied to school computer applications.

Figure 2.2
A Systems Analysis Process Model



CHAPTER 3
Preliminary Analysis

Problem Isolation

The first concern of a systems analysis is determining the administrative problems which exist in your school. These problems can range from the simple to the complex, from inaccuracies in the names and addresses of students and staff to a failure of the accounting or grade-reporting system.

A typical systems analysis approach is to gather and list the problems specific to your organization. For our purpose, we will limit the problem list to those problems reflecting paperwork and processing problems, that is, those most amenable to computer solution.

You may already be familiar with the problems, or it may be useful to have your school staff assist in generating a problem list. There may be many other problems you would like to solve including those associated with difficult students, high noise levels, and inadequate financial and/or physical resources. Unfortunately, these problems are not easily solved through a computer application. For a school, typical problems that are amenable to computer solutions might include:

- Inability to quickly prepare reports, including grade reports, grade analyses, student directories, or enrollment counts
- Inadequate statistical analysis of student demographic characteristics
- Poor scheduling of teachers, students, and classrooms
- Inaccurate and/or poorly maintained budget and accounting records
- Difficulty in producing student activity or cafeteria fund accounting reports
- Heavy typing requirements
- Difficulty determining when library or media center items are overdue, or in ascertaining who has checked out which items
- Difficulty in projecting budgets
- The need to generate mailings to parents and special groups
- Outdated or inaccurate mailing lists

This list may be familiar to many school teachers and administrators. Unfortunately, a school (or school district) is rarely able to attempt to immediately solve all of the problems it has identified. Consequently, you may have to find a way to prioritize your list. This is the topic of the following section.

Constraints and Resources

Generally, the problem identification process delineates more than one problem. This makes it important to prioritize your problem list. The prioritization may be based on personal preference, however, it is more frequently shaped by the constraints (limiting factors) and resources available to your school or district. These constraints and resources will affect how you approach implementing a computer solution, and may even determine whether or not a computer solution is feasible. Examples of constraints and/or resources include:

Financial constraints

- The amount of money available for implementing a computer solution
- Funding or budget cuts
- Receipt of a new grant or a budget windfall

Personnel constraints

- Level and number of individuals who could work on implementing a computer solution
- Loss of personnel
- Extra volunteer help
- Levels of skill among existing school or district staff
- Space and facility constraints; Is there space available for a new system?
- Are there sufficient electrical connections for a computer system?
- Will noise levels be a problem?
- Are there other environmental issues that must be considered?

Time constraints

- Are you under time pressure to implement a new system?
- Do specific budget amounts need to be spent within a short period of time?

Other constraints

- Ownership of certain types of hardware or software
- Directives from management or another agency to resolve a problem or provide certain statistical reports
- The need to provide challenges for bright staff members.

Computer hardware issues, including the amount of disk storage space needed, and software concerns, such as an application software package's memory requirements are also matters of concern. Frequently, existing hardware and software constrain the system design. In this book, we assume adequate hardware and software is either available, or could be purchased as needed. Information on choosing hardware and software is covered in Chapter 5.

User Needs

In our concern with isolating and prioritizing problems we should not forget the user. It is important to perform a user needs assessment. The results of a user needs assessment should be matched against current school services and products to isolate problem areas. Questionnaires, interviews,

and observations are a few of the techniques which can be used to gather information on user needs. For example, we could request teachers, students, and parents to complete a questionnaire on school services.

A typical questionnaire might request the school community to indicate their familiarity with computers, how useful they think computers are, how computers could be used in instructional and administrative functions, how current and up to date school district computers should be, and their reactions to the following questions:

- What products would be most useful at our school?
- What services provided by the school could be done better with computer support?
- Does the staff have the requisite skills to implement a computer solution to identified problems, or will additional training be required?
- What environmental considerations should be taken into account?

Chapter 10 discusses the importance of user needs in establishing an automated system. The Bibliography contains a number of references which provide more detailed information on user needs assessment methods and instruments.

Understanding the Organization

The nature of the organization and the people within it can also have an effect on both the problem and its solution. It is helpful to understand the structure of your organization. In particular, you will want to know which units are interrelated within the school and which units have relationships with organizations outside of the school. You also need to be familiar with the people, position classifications and reporting procedures that affect the operation of your school or school district. An analyst may want to review annual reports, minutes of meetings, and personnel descriptions to get a sense of the relationships that exist. It is also helpful to review existing organization charts, or to draw such charts if none exist.

Depending on the nature of the problems you are considering, knowledge of the organization can help define the issues you will face and will help you understand how those problems are affected by the organizational structures and personnel employed within the system. Without an understanding of the potential impact of a new computer system on the organizational climate of your school, it may be very difficult to use the computer as an effective solution for your problem. For a more in-depth discussion of this topic, see Chapter 10.

Other Issues

There are a number of other issues which you should consider before you begin prioritizing problems including:

- Using an application that has been implemented successfully elsewhere for your first attempt at computerization
- Start with a simple problem and move to more complex issues as you gain experience. This will provide you with progressional growth in

computer learning

- Consider a modular approach. Choose problems which "fit" together to develop an integrated application. For example, develop a student record system which includes a number of modules including: student scheduling, grade reporting, test analysis and scoring, attendance, transcripts, and statistical and other specialized report generation
- Isolate major problem subsystems, that is, areas in the school where the majority of problems exist

Operational Review

Other approaches to the isolation of problem areas include asking a set of basic questions about the school's operation. Typical questions include the following:

- Are there areas with large information processing needs, that is, high

Figure 3.1
Operation Review Chart—Student Administrative System
Example: Records and Scheduling

Activity	A Information Processing Needs	B Retrieval Problems	C Repetitive Clerical Routines	Row Total
Student demographic data gathering	2	1	1	4
Student health data gathering	2	1	1	4
Student data record creation	3	1	3	7
Student demographic report creation	3	3	3	9
Student health report creation	2	3	3	8
School data creation	2	1	3	6
Teacher data creation	1	1	3	5
Class data creation	3	1	3	7
Student scheduling	3	3	3	9
Homeroom assignment	2	3	2	7
Mailing label creation	2	1	3	6
Teacher lists	2	2	3	7
Address lists	2	2	3	7
File updates	2	2	3	7
Statistical reports	2	2	3	7
Health/immunization reports	2	3	3	8

A	B	C
0 not applicable	0 not applicable	0 not applicable
1 low processing needs	1 no problems	1 few routines
2 medium processing	2 minor problems	2 medium level
3 high processing	3 major problems	3 high volume

volumes of inputs and/or outputs, and heavy processing requirements?

- Are there information retrieval problems such as reports not submitted on time, the inability to generate reports or information on important issues, inaccurate reports, or data quality problems?
- Are there areas with a large number of repetitive, clerical functions?

To determine which problems should receive highest priority, you could list all the activities, functions, tasks or processes in your school and consider each one in light of the three questions above. If you establish rating criteria for each of the three questions, you could then rate each activity, function, task and process using those criteria. By summing the rating for each activity, you could determine which should receive your attention first. Figure 3.1 displays an example of this approach applied to a student record and scheduling module, and Figure 3.2 shows an example of this approach applied to a library/media center acquisition module.

From these examples, it would appear that the following are likely problem areas for consideration:

- Student demographic and health reporting and student scheduling (and related activities since all are fairly highly rated)
- New title list generation for new Library/Media Center materials

Microcomputer software could be used to assist in preparing these charts and to assist in problem area refinement. A spreadsheet package, or

Figure 3.2
Operational Review Chart—Library/Media Center Review
Example: Acquisitions

Activity	A Information Processing Needs	B Retrieval Problems	C Repetitive Clerical Routines	Row Total
Material selection	1	1	1	3
Bibliographic checking	2	1	1	4
Order preparation	2	1	3	6
Order distribution	1	0	3	4
Accounting for materials	2	2	2	6
Receiving and checking	2	1	2	5
Claiming	1	2	2	5
Processing and distribution	2	1	3	6
New title generation	2	3	3	8

A	B	C
0 not applicable	0 not applicable	0 not applicable
1 low processing needs	1 no problems	1 few routines
2 medium processing	2 minor problems	2 medium level
3 high processing	3 major problems	3 high volume

the spreadsheet component of an integrated package, could be used to format the tables displayed in Figures 3.1 and 3.2. The spreadsheet would also calculate the row totals, and allow us to sort the information by those totals to see how each activity has been ranked. Example 1 shows you how Lotus 1-2-3 can be used to create and analyze the data in Figure 3.2.

Organizational Goals and Objectives

Although they are not always formally stated, every organization has goals and objectives. They provide a plan for the future and offer benchmarks to measure how well the organization is meeting that plan. These goals and objectives provide criteria for evaluating the systems that make up the organization. Therefore, an understanding of the organization's goals and objectives is crucial to listing and prioritizing problems.

For our purpose, a goal is a long-range plan or a major end result. An objective is a shorter range task which must be successfully completed in order to attain a specified goal. Objectives are the "means to an end." Another distinguishing factor between a goal and an objective is that goals tend to be broad statements of purpose, while objectives are narrower and frequently stated in quantitative terms. If an organization has specified its goals and objectives, they should be considered as problems amenable to a computer solution.

The following goals, if available to the analyst, would help prioritize problems in need of a solution:

- Simplify student record keeping procedures and provide more timely information to school sites
- Improve the timeliness of report generation for student demographic information and class scheduling
- Reduce data processing costs while improving the level of service
- Increase awareness and use of library/media materials and services through better publicity regarding resources, programs and services
- Improve communications between the central office and the school sites
- Develop greater awareness about school district programs and plans
- Provide school sites with the resources to successfully implement school site budgeting

While a school's goals may cover many areas, the list shown above contains a number of goals related to student records maintenance and scheduling, and Library/Media Center awareness.

Problem Definition and Requirements List

Once we have determined which problem(s) we want to consider further, it is important to describe those problems in more detail and outline the requirements of the system to alleviate the problem. System requirements are the specification of tasks associated with resolving the problem. You can think of these system requirements as functional requirements that outline which functions the system should perform. Figures 3.4 and 3.5 offer examples of expanded problem definitions and lists of system require-

Example 1
Using Lotus 1-2-3 to Develop an Operation Review Chart

Spreadsheets provide a convenient way to analyze a group of options to ascertain which should be considered first as you develop your computer application. Spreadsheets are a very flexible tool that allow you to enter a variety of numeric and textual data and conduct a wide range of calculations on those data. This example shows you how to use Lotus 1-2-3 to enter the data displayed in Figure 3.2, and how to rank each activity based on the number of points assigned to each of those activities. The example assumes you have some familiarity with Lotus, and that you know how to start the program, use the front-slash key (/) to access the menu, and exit from Lotus.

Begin by starting Lotus on your computer. Lotus automatically assigns each column in the worksheet a width of nine characters. Since you want to be able to put the full name of each activity in the first column, you will have to tell Lotus to make some of the columns wider. To do this, be sure your cursor is in column A, and type the following command:

/Worksheet Column Set-width 33 [CR]
[CR] indicates the enter or return key

You will see that column A is now 33 characters wide. Make columns B, C and D each 13 characters wide by placing the cursor in each column respectively and typing the command:

/Worksheet Column Set-width 13 [CR]

There is no need to change the width of any other columns at this time.

Before entering the information displayed in Figure 3.2, it is always a good idea to put a title at the top of the worksheet. Move your cursor to cell A1 (The easiest way to do this is to press the "Home" key on your number pad). From cell A1, type:

"Library/Media Center Review Example: Acquisitions" [CR]

Don't worry about the fact that this label is more than 33 characters long. As long as you don't put anything in cell B1, the entire title will appear on your screen.

The next step is to enter the table headings. Note that the longest headings will require three rows, while the shortest, only one. Move to cell B7. Before you enter the first part of the heading for this column, you want to center it in the column. You can do this by typing a ^ (shift + 6) before the heading itself. Thus in this cell you would type:

^ Information [CR]

Now fill in the rest of the headings yourself. Don't forget the "Row Total" column. We didn't change its width, and if you have an 80-column display, you won't see column E on the screen until you use the right

Example 1
Using Lotus 1-2-3 (Continued)

arrow key (—>) to scroll to the right. Remember to use the ^ symbol to center text within each cell. This will make your final table look neater and make it easier for others to read.

Another nice editing touch would be to draw a line below the headings before you actually enter the data. If you used three rows for the headings, the row below the headings should be row 10. Place your cursor in cell A10 and type:

\ -

Note that this is a backslash, and not the front-slash you use to access the Lotus menu. The backslash is the Lotus repeating key. Lotus will fill the cell with whatever character you type immediately after the backslash. In this case, the cell filled with dashes. It is better to use the repeating key to fill a cell then to attempt to fill in the correct number of dashes because if you decide to change the width of the cell at a later time, Lotus will automatically fill the cell with dashes. If you had simply typed 33 dashes, not only would it have taken longer, but if you made the column 35 characters wide later, you would have to go back and add two more dashes.

You can now use the Lotus Copy command to copy the dashed line into the four other columns. Place the cursor in cell A10 and type the following keystrokes:

/ Copy [CR] [Right arrow] .[Right arrow]
[Right arrow] [Right arrow] [CR]

The dashes will now fill in columns B through E. The copy command is one of the most powerful features of any spreadsheet. You should take the time to read the documentation that came with your spreadsheet program to make sure that you understand how to use this feature.

If you move the cursor to cell A11, you can begin entering the data from Figure 3.2. In the first row, you should enter the following information into the cells:

Column	*Entry*
A11	**Material Selection**
B11	**1**
C11	**1**
D11	**1**
E11	**@SUM(B11..D11)**

Notice that we did not type in the row total, but instead we entered a formula that tells Lotus to sum the values in cells B11 through D11. By doing this, if you change one of the values in columns B,C or D, the new row total will automatically be calculated. This will enable you to conduct

Example 1
Using Lotus 1-2-3 (Continued)

a "what-if" analysis later to see what impact different assumptions about the importance of each of the three criteria are for each activity. For now, simply finish filling in all of the columns except for the row totals.

When you have entered all of the data except for the row totals, move your cursor to cell E11. Now you are going to copy the formula in this cell to the other cells in this column. To do this, type the following:

/ Copy [CR] [Down arrow].

Now move the cursor down to E19 by pressing the down arrow, then press:

[CR]

Note that the cursor returns to cell E11, and that the row totals appear for each row in the table. Move your cursor down to cell E12. Note that Lotus automatically changed the formula to account for the fact that you are in a different row. This is one of the most powerful features of a spreadsheet. Once you have determined what the correct formula should be, you can replicate it very easily, and the program itself will adjust the cell references automatically. Of course there will be times when you want to disable this feature. Your documentation will tell you how that is done.

All you have to do to complete the table is draw a line on the bottom of the table and add the legend. If you want to change the value assigned to one or more of the activities, all you have to do is move the cursor to the cell you want to change, and type in the new value. Lotus will automatically recalculate the row total for you.

In this example, it is easy to look at the nine entries in the table to determine which has the highest total and should be considered initially for development of a computer application. However, if you had many more activities, say 50 or 100, scanning the list would be tedious and you might miss a highly problematic activity. Fortunately, Lotus has the capability to sort this table by the values in the row total column so that the highest ranked activity appears at the top, and the lowest ranked activity at the bottom.

To sort the table by row total, place your cursor in cell A11, the first row of data entries. Now type the following series of commands:

/ Data Sort Data-Range

The Data Range command asks you to identify the data that is to be sorted. Since you want to maintain the integrity of each line, you must include all of the information between the two dashed lines in the Data-range. If your cursor is on cell A11, press the period (.), and then use the arrow keys to move right and down until the entire area between the

Example 1
Using Lotus 1-2-3 (Continued)

lines is highlighted. then press:

[CR]

You will now see the Data menu again. Choose the

Primary-key

option. Then move the cursor to the row total column, and press

[CR]

Lotus will ask if you want to sort the data in Ascending or Descending order. Since we want the activity with the highest total to be at the bottom of our list, choose

Ascending and press **[CR]**

You will see the Data menu again. Since you are ready to sort, choose:

Go

In a few seconds, Lotus will sort the data and re-display it in descending order based on the row total column. If you did this correctly, your worksheet should look something like Figure 3.3. Now you can easily see which activities should be considered first. If you change any of the ratings in the worksheet, you will have to re-sort the data to get the activities in ascending order.

Figure 3.3
Lotus Spreadsheet Output for Data From Figure 3.2

Library Media Center Review Example: Acquisition

Activity	A Information Processing Needs	B Retrieval Problems	C Repetitive Clerical Routines	Row Total
Material selection	1	1	1	3
Bibliographic checking	2	1	1	4
Order distribution	1	0	3	4
Receiving and checking	2	1	2	5
Claiming	1	2	2	5
Order preparation	2	1	3	6
Accounting for materials	2	2	2	6
Processing and distribution	2	1	3	6
New title generation	2	3	3	8

ments in two areas—Student Records and Scheduling and the Library/Media Center.

In addition to these requirements, specific information about the system itself will be required. This information specifies the unique characteristics of the school and provides more details about the features desired in a new system. Among the specific pieces of information required for the student record keeping and scheduling system are:

- The number of schools expected to be part of the system
- The number of faculty and number of students, specified by school level, in each separate application level. For example, data for the entire student body may be in the student record system but only a portion of this data could be used in a scheduling system
- The number of fields and data elements for each student or faculty record
- The capability for handling personal data, such as locker number and language capabilities

Figure 3.4
Sample Problem Statement 1: Student Records and Scheduling

Problem Statement

A survey of administrators, staff, and teachers found genuine concern over the operation of the student record/scheduling system. At the present time, the system operates in batch mode, with limited interactive scheduling capacity. It is maintained by an outside data processing service bureau. Information used to update the student data base is recorded on code sheets which must be sent to the service bureau.

Frequent delays occur between the time the records are sent to the service bureau and the time they are actually input into the student scheduling data base. There have also been substantial delays in receiving critical student record reports, such as the master student list for each school, and accurate class schedules. Users of these reports also complain about the difficulty of finding needed information quickly in the bulky printouts they receive.

Requirements List

- Interactive data entry and retrieval
- Ability to query system for information on individual students, teachers, and class schedules
- Generation of the following reports:
  - Master student lists
  - Master class schedules
  - Teacher lists
  - Homeroom enrollment and attendance lists
  - Address labels for students, parents or teachers
  - Immunization reports
  - Other statistical summaries as required by the district or the state

- The ability to enter additional data, such as student enrollment in special education and bilingual programs
- The number of courses and number of course requests per student
- The number of school shifts, type of school cycle, and type of scheduling system (semester, trimester, quarter, or full-year)
- The number of periods in a day
- Distinctions between required and optional classes
- Ability to handle co-requisite courses
- Study hall assignments and scheduling
- The ability to create specific reports, such as student lists by advisor, student name, courses, grade level, or homeroom
- The frequency production for each report

Objectives

Once you have prioritized your problem list, and created a list of system requirements, you can develop a set of objectives for each program area being considered. The purpose of these objectives is to provide a quantitative basis for judging the success of the application. The process is simply to take the problem statement and requirements list and rephrase them into standard objectives terminology. A list of objectives for the

Figure 3.5
Sample Problem Statement 2: Library/Media Center

Problem Statement

A user needs assessment indicated that faculty (as well as administrators and students) want to be apprised of new Library/Media Center acquisitions. At the present time, new materials lists must be generated through manual typing. There is frequently a typing backlog in the Library/Media Center office. Typing a new acquisitions list on a monthly or bi-monthly basis would create problems for an already overburdened staff. In addition, it would be difficult to provide the faculty with up-to-date lists because our faculty name and address file is outdated. Even if we could keep it updated, there is no simple way to generate mailing labels for distribution of the list.

Requirements List

- Create a faculty name and address file
- Maintain the faculty file (add, change, delete items)
- Create a file listing new materials acquisitions by the Library/Media Center
- Maintain and update this new acquisitions file on a regular basis
- Create a periodic report describing new materials and distribute this in the Library/Media Center.
- Generate a selective mailing of the new materials report, and mail it on a monthly or bi-monthly basis to teachers, administrative personnel and interested parents.

student record keeping and scheduling system might look something like this:

Problem Objectives: Student Records and Scheduling
To inaugurate an improved student record and scheduling system which will:

- Operate interactively
- Generate required reports on demand
- Not increase operating costs

Problem Objectives: Library/Media Center
Satisfy user needs through:

- Generating of a periodic report listing new acquisitions
- Distributing of this monthly report in the Library/Media Center
- Sending the report to faculty and administrative staff on a monthly basis

Benefits

There is no reason to develop a new system unless it will improve the ability to provide current services or to offer new services to the students, parents or faculty of the school or school district. Often, you will need to generate a list of benefits that will accrue to the school if a new system or application is developed. A list of benefits that might result from the development of a new student record keeping and scheduling system include:

- An easier-to-understand and more timely student scheduling procedure
- More accurate report on student attendance, enabling the district to maximize its per pupil funding from the state
- Reduced teacher and student dissatisfaction because of the increased accuracy of the record keeping and scheduling system
- Improved teacher and administrative productivity resulting from better, more timely, data on students and class offerings

Benefits which might result from the development of a new Library/Media Center system include:

- Increased satisfaction with the Library/Media Center
- Increased awareness of Library/Media Center resources
- Increased use of the Library/Media Center

Management Plan

Before proceeding to the next step of our systems analysis model, input and output analysis, it is useful to develop a management plan. A management plan can help you determine when specific tasks need to be done. It can provide you with a checklist of what should be done at what time, and it provides a good communications tool for management. Below, the tasks associated with conducting any systems study are delineated. Typical system study steps are shown in Figure 3.6.

Specific time and management techniques include Gantt and PERT charts. Gantt charts are two-dimensional arrays which provide lists of tasks

and time frames. Figure 3.7 provides an example of a Gantt chart used for implementing a new generic application.

Additional project time management techniques include PERT (Project Evaluation and Review Technique) and CPM (Critical Path Method) charts. A PERT chart consists of placing tasks (identified by the task number placed into a circle or by the task name placed into a box) into a sequence of performance. These tasks can be events, or the start of a task which does not involve time; or activities, which lead from one task to another and involve the consumption of time. Simultaneously occurring tasks can occur in any project and these can be illustrated easily in a PERT chart. (This is an advantage of PERT charts over Gantt charts.) The numbers on the chart indicate average time estimates for task completion. Additionally, one could include time estimates on the chart for minimum and maximum time to complete a task. An example of a PERT chart is shown in Figure 3.8.

Through the use of the CPM, one can determine the shortest time within which a project will be completed. The critical path is the longest path through the PERT chart—any change in time on the critical path will affect the projected completion time of the project. The critical path is noted by the darker line on the chart. By adding the average estimate times along the critical path, one can determine the minimum time in which a project will be completed. It should be noted that modifications can occur along the path,

Figure 3.6
Systems Study Steps

Typical System Study Steps

1. Isolate the problem(s)
2. Understand user needs
3. Determine the resource constraints
4. Identify specific problems
5. Outline the system requirements
6. Develop a preliminary analysis
7. Establish a management plan
8. Analyze existing forms and files
9. Analyze system documents
10. Determine input requirements and define data elements
11. Determine output requirements
12. List system task requirements
13. Flowchart the process
14. Select software
15. Select hardware
16. Outline implementation tasks
17. Perform implementation tasks
18. Procure hardware, software and personnel training
19. Outline housekeeping procedures
20. Develop system documentation
21. Create a publicity program to inform system users of the changes
22. Implement the publicity plan
23. Test the system
24. Train your staff
25. Implement the system
26. Establish feedback mechanisms
27. Evaluate the results

such as when a task is completed in less time than originally estimated. In these instances, a new time estimate for project completion is calculated.

There are a number of microcomputer software packages that assist in project management. These include such packages as MacProject, Harvard Total Project Manager, and VisiSchedule. Each of these packages allows one to define tasks and to determine time frames; to display the tasks and times of the project in a tabular form; to calculate project schedules and critical paths; and to allow for project monitoring and task/time updating. Information on these packages is found in Appendix 2.

Summary

The preliminary analysis phase of a systems study involves the definition of the problem(s). The analyst gathers all relevant data which might assist in defining the problem, including a determination of constraints and resources available, organizational structure and tasks, goals and objectives, and user needs. With the problem defined, the analyst outlines the system requirements and develops a management plan of action. Once the preliminary analysis is complete, you can progress to the next step of a system study, the analysis of inputs and outputs.

Figure 3.7
Gantt Chart

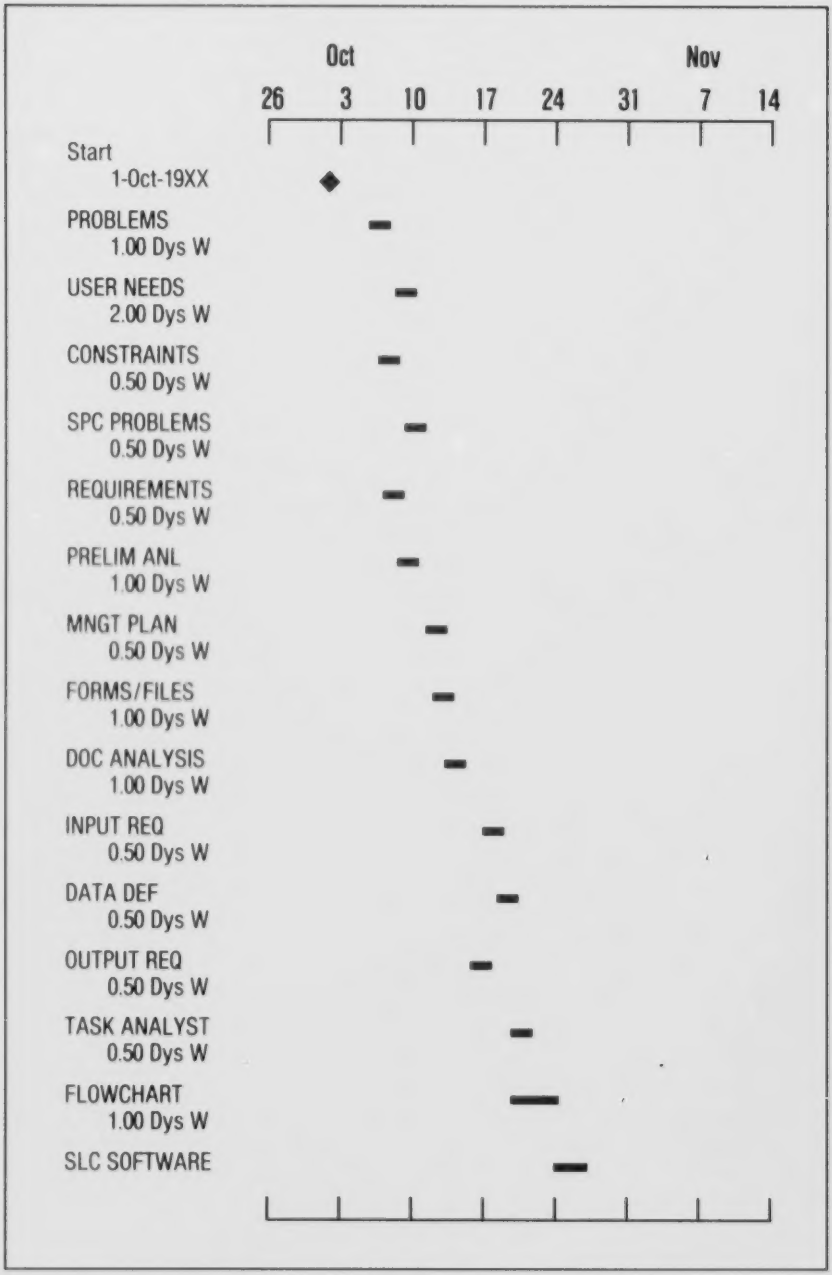


Figure 3.7
Gantt Chart (Continued)

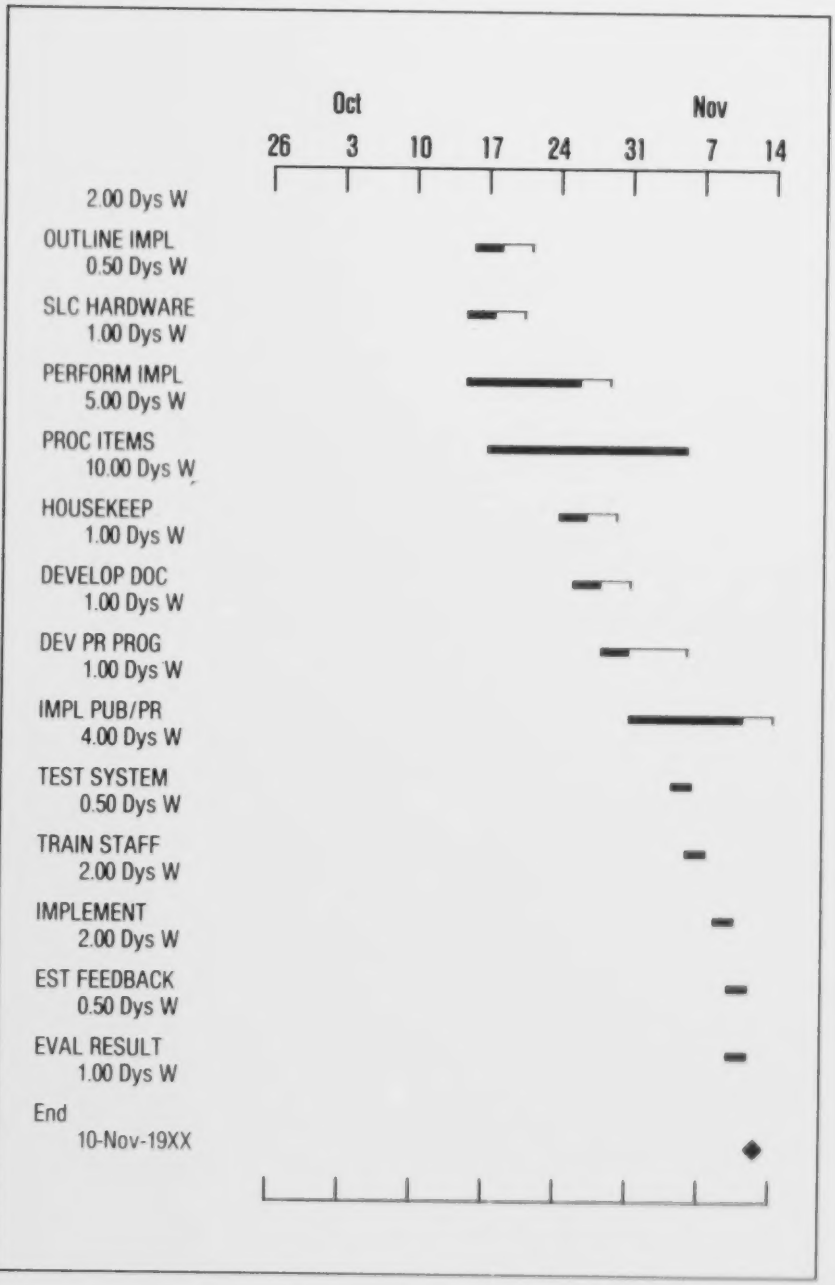


Figure 3.8
PERT Chart

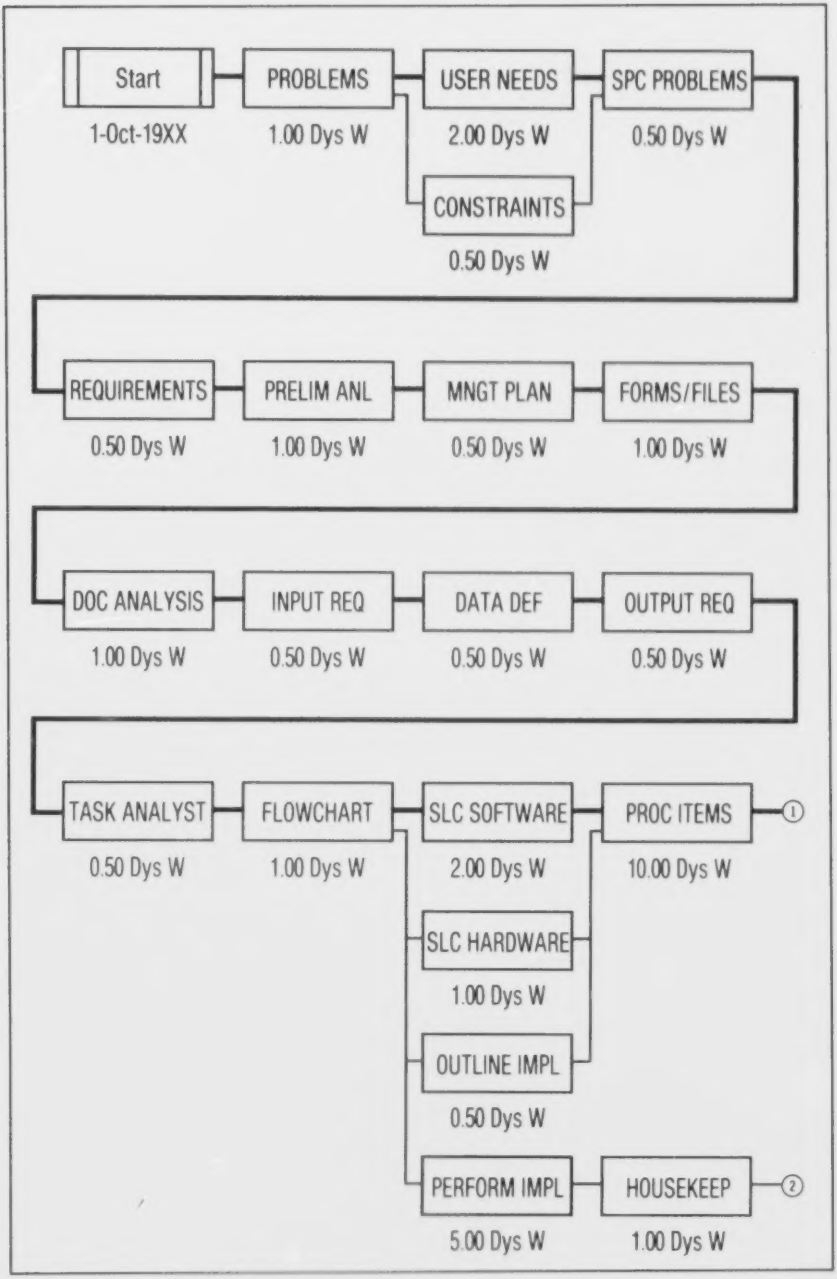
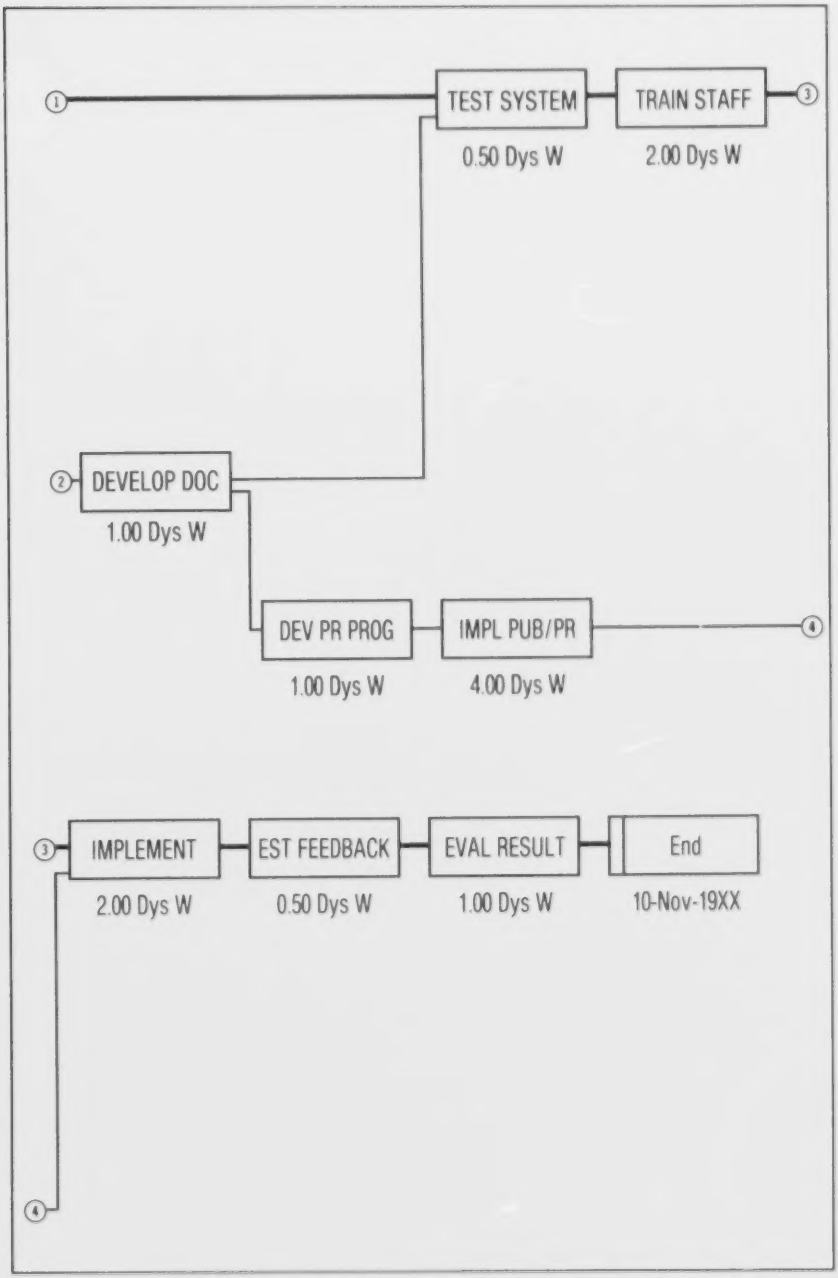


Figure 3.8
PERT Chart (Continued)



CHAPTER 4
Input and Output Analysis

A system consists of three elements: input, output, and process. A model of a simple system is shown in Figure 4.1. The elements of a model include inputs, processes and outputs.

- An input is that which activates a system
- A process is the activity which translates an input to an output
- An output is a product of a process

The success of a computer solution to your problem depends heavily on your ability to carefully define the inputs to the system, the manner in which they will be processed, and the design of your outputs. This chapter discusses inputs and outputs, while Chapter 5 describes processing analysis.

Forms and Files

Although one can think of a wide variety of inputs that affect school administration, information about community attitudes and issues of school policy are the most common types. The inputs that are most amenable to traditional systems analysis are forms and files. Typical form inputs in a school include pupil enrollment forms, attendance registers, certificated and classified position applications, purchase orders, library charge cards and student grade reports. Additionally, inputs may be files. Examples of files include student record files, equipment inventory lists/files, on-order files, accounting files, vehicle maintenance records and physical plant repair files.

For a systems analyst to design a new system, he or she must under-

Figure 4.1
A Simple System Model

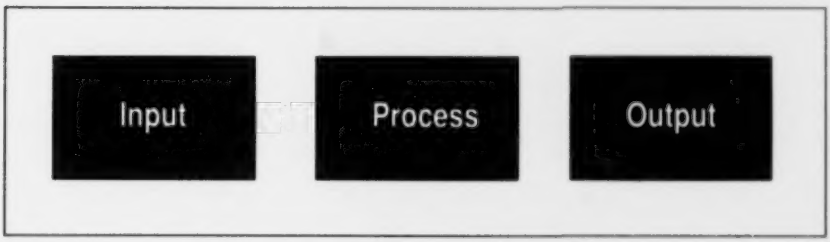


Figure 4.2
Forms Analysis Example 1: Student Enrollment Form

Name of Form: Student Enrollment Form (non-health & immunization data)

Alternate Names: Enrollment Form, School Enrollment Form

Physical Characteristics:

1. Medium: medium paper stock
2. Size: 8-1/2" x 11"
3. Copies: two plus original
4. Color: white with green printing; copy 2 - yellow; copy 3 - pink
5. Other: overside blank

Coded Elements:

1. Ethnicity code (e.c.)
2. Verification and source of verification
3. Student number
4. School number
5. Homeroom or teacher number
6. Special program code
7. Transportation code

Cost of Form: $95.00 per 1000 from printing department (order number: 18115)

Data Elements:

			Number of Characters			
Field #	*Data Elements*	*Frequency*	*Min*	*95%*	*Max*	*A/N*
1	Student number	always	9	9	9	N
2	School number	always	3	3	3	N
3	Grade	always	2	2	2	N
4	Sex	always	1	1	1	A
5	Name	always	5	18	25	A
6	Social Security number	sometimes	9	9	9	N
7	Street	always	18	30	33	A
8	City	always	5	19	20	A
9	State	always	2	2	2	A
10	Zip code	always	5	5	9	A
11	Home phone	always	12	12	12	N
12	Emergency phone number	always	12	12	12	N
13	Birthdate	always	6	6	6	N
14	Birthplace	always	7	20	25	A
15	Parent or guardian (male)	sometimes	5	18	25	A
16	Occupation	sometimes	7	10	20	A
17	Employer	sometimes	3	20	25	A
18	Employer phone/address	sometimes	12	12	25	A
19	Birthplace	sometimes	7	20	25	A
20	Citizen of	sometimes	3	3	25	A
21	Parent or guardian (female)	sometimes	5	18	25	A
22	Occupation	sometimes	7	10	20	A
23	Employer	sometimes	3	20	25	A
24	Employer phone/address	sometimes	12	12	25	A
25	Birthplace	sometimes	7	20	25	A
26	Citizen of	sometimes	3	3	25	A

Figure 4.2
Forms Analysis Example 1: Student Enrollment Form (Continued)

Field #	Data Elements	Frequency	Number of Characters Min	95%	Max	A/N
27	Language at home if not English	sometimes	4	10	25	A
28	Last school attended	sometimes	4	10	25	A
29	School address	sometimes	30	56	64	A
30	Grade attended previously	sometimes	1	1	2	N
31	Last date attended other school	sometimes	6	6	6	N
32	Names of sisters and brothers	sometimes	5	18	50	A
33	Ages	sometimes	1	10	25	N
34	Ethnic code (e.c.)	sometimes	1	1	1	N
35	Verified?	always	1	1	1	N
36	Source	always	1	1	1	N
37	Initials	always	2	2	2	A
38	Entry date	always	6	6	6	N
39	Homeroom or teacher number	always	4	4	4	N
40	Enrollment date	always	6	6	6	N
41	Special program or special ed.	sometimes	2	3	3	N
42	Locker number	always	4	4	4	N
43	Transport code	always	3	3	3	N

Coded Elements:

Student number: Social Security number or sequential number of enrollee

School number: Unique number assigned to each school in the district

Ethnicity: 1=Black; 2=Hispanic; 3=Asian/Pacific Islander; 4=Caucasian; 5=Native American; 6=Other

Verified: y=yes; n=no

Source: 1=birth certificate; 2=affidavit ; 3=baptismal 4=passport 5=registration card; 6=other

Homeroom: Unique number assigned to each room in school

Teacher number: Unique teacher identification number

Special program codes: 1=gifted/talented; 2=disadvantaged ; 3=handicapped program ; 14=handicapped program; 25=handicapped program ; 36=ESL

Special Education: Unique number assigned for each category code.

Transportation: Unique number assigned to each bus route and specific bus stop.

Activity: The Student Enrollment Form is completed by a parent or guardian at a specific school in the District. It is completed the first time a student is to enroll in the school or is returning after an absence. The school provides the form. After the parent or guardian completes the form, school staff verifys the data. The original and second copy (yellow) of the form are filed in the student enrollment file, the pink copy is sent todata processing.

Use: Most of the forms are generated at the beginning of the school year, with each school contributing an average of 150 forms including new kindergarten enrollments. About five new forms are completed per month at other times.

Figure 4.3
Student Enrollment Form

The School District — Student Enrollment Form

F84-123

PLEASE: Use ballpoint only
Parents do not write in shaded areas
Sign and date completed form

student number	school no.	grade	check one ☐ boy ☐ girl
student name (last, first, middle)			social sec. no.
street address		city	zip code
home phone no.	emergency number	birthdate	birthplace

Information regarding parent/guardian (male):

name (last, first, middle)		birthplace	citizen of
occupation	employer		address or phone

Information regarding parent/guardian (female):

name (last, first, middle)		birthplace	citizen of
occupation	employer		address or phone

language at home other than English		
name of student's previous school		
school address	grade attended	last date attended
names and ages of other children in family		

e.c.	verified: ☐ yes ☐ no	verified source
initials	today's date	enrollment date
homeroom/teacher no.	special program/sp ed	
locker no.	transport codes	

stand the current systems. This includes detailed knowledge of the forms and files currently in use. Understanding these inputs will enable the analyst to determine the computer system size and the configuration that will meet the school or district's needs, and aid in the design of computer input formats, record structures, and outputs.

Forms Analysis

The specific data that need to be collected about forms include:

- Name of the form (official)
- Alternate name of the form (popular, unofficial name), if one exists
- Cost of form and order information
- Physical characteristics of the form, i.e., medium, such as paper print out, screen readable, or microform; size; copies
- Data elements (fields of data on form and their characteristics). It is typical to include the following type of information on data elements:
  1. Frequency of occurrence of the data
  2. Minimum number of characters per data element
  3. Maximum number of characters per data element
  4. The 95 percent percentile, or the maximum length of 95 percent of the data
  5. Whether the data is numeric or alphanumeric
- Coded elements (form ID number, etc.)
- Activity/origin/distribution, i.e., in which subsystem or area does the form originate? Where is it sent? Who uses it or fills it out? Where are copies distributed? Rate of use (e.g. per hour per day)

Figure 4.2 contains an analysis of a student enrollment form using the model described above. A copy of the actual student enrollment form is displayed in Figure 4.3. Similarly, Figures 4.4 and 4.5 contain an analysis and copy of a Library/Media Center on-order form respectively.

File Analysis

Comprehensive data about files must also be collected. A file analysis would include a description of the following items:

- File name (official)
- Alternate file name (other names for the file)
- File location (location in office; location on floor plan)
- Forms contained in the file
- A physical description of the file
- Medium (paper or computerized)
- Number of drawers (if paper)
- Sequence of drawers (if paper)
- Location of disks (if computerized)
- Backup procedures
- File size
- Growth pattern (projected over a period of time)
- File sequence (e.g., name or title sequence, specific filing rules)

Figure 4.4
Forms Analysis Example 2: Library/Media Center Order Form

Name of Form: On-order form

Alternate Names: Multiple-order form; order form; MOF; OOF form

Physical Characteristics:

1. Medium: thin paper
2. Size: 3" x 5"
3. Copies: five sheet set
4. Type of paper: carbonless
5. Color: yellow
6. Other: before use form was part of a perforated set which is part of a sheet of 4 sets

Cost of Form: $47.50 per 1000 when 5000 sets ordered. Gaylord Brothers Catalog number 545.

Data Elements:

			Number of Characters			
Field #	*Data Elements*	*Frequency*	*Min*	*95%*	*Max*	*A/N*
1	Class number	always	5	5	5	N
2	Author	always	5	105	120	A
3	List price	sometimes	4	4	6	N
4	Title	always	4	110	118	A
5	Date ordered	always	6	6	6	N
6	Date received	always	6	6	6	N
7	Edition/series	sometimes	1	2	5	A
8	Volume(s)	sometimes	1	3	3	A
9	Dealer	always	2	2	3	A
10	Place	sometimes	8	25	30	A
11	Publisher	always	10	28	30	A
12	Year	sometimes	4	4	4	N
13	Number of copies	always	1	2	3	N
14	Received by	always	2	3	3	A
15	Fund charged	always	3	3	3	N
16	Cost	always	3	4	5	N
17	Order Number	always	5	5	5	N
18	Library of Congress Card	sometimes	8	8	12	A
19	Blank space for receipt date					

Coded Elements: None

Activity: The form is used primarily by Library/Media Center staff to verify order information, e.g., checking to verify whether an item is on order in response to a request, or as part of the acquisitions bibliographic checking process. Forms are filed in the on-order file by staff when an item is placed on order. The form is dated with the receipt date of the item in acquisitions, and it is removed from the file when the item has been processed by cataloging.

Use: About 25 forms are filed each week; a similar number are pulled from the file each week.

- Activity (use patterns, number of individuals, frequency of use, when used, time of day, week or year)
- Updating and life expectancy characteristics (when and how is the file updated, retention and destruction cycle)
- Access privileges

Figure 4.6 contains an analysis of a student enrollment file, and Figure 4.7 an analysis of a Library/Media Center order form.

Output Analysis

At the beginning of this chapter we said that an output is the product of a process. The same techniques used to describe inputs can be used to describe outputs, specifically, the use of form and file analysis. In simple terms, a form or a file could be either an input or an output, depending on the circumstances. For example, the Pupil Enrollment File would be considered an input if used to search for information on a specific student or group of students. It would be considered an output when it is the final product generated from filing the student enrollment forms, such as a student enrollment count by ethnicity sent to the district office once a month. Don't forget that printouts and screen displays from computerized systems are also outputs and can be subjected to the same output review process as printed forms and manual files.

If the purpose of a system analysis is to help design a replacement system, existing outputs can be analyzed. If a new application is being designed, output may not exist. In this case, a description of the output, in

Figure 4.5
Sample Library/Media Center Order Form

CLASSNO	AUTHOR		
LIST PRICE	TITLE		
DATE ORDERED • DATE REC'D	EDITION/SERIES		VOLUME
	PLACE	PUBLISHER	YEAR
DEALER			
NO. OF COPIES	RECOMMENDED BY	FUND	COST
ORDER NO.		XYZ P.O. BOX 1 CITY, ST, 00000-0000	
LCCARD			

addition to a listing of the specific data elements that are required, needs to be developed during the design phase of the systems analysis.

Summary

The input and output analysis phase involves the gathering, and detailed description of, forms and files used in the application. Once this analysis of system inputs and outputs is complete, the user can proceed to the processing phase. Processing is the topic of the next chapter.

Figure 4.6
File Analysis: Example 1—Student Enrollment File at the Individual School Site

Name of File:	Student enrollment file
Alternate Names:	Enrollment file, pupil enrollment file, current student enrollment file
Location:	Behind the school office counter
Forms in File	Student enrollment forms
Physical Description:	2 4-drawer metal filing cabinets dimensions of: 15"w x 25-1/16" d x 52" h per cabinet $150 per cabinet alphabetical guides provided in drawer
Size:	One drawer can hold approximately 150 student enrollment files (one drawer is allocated to the student enrollment files); the remaining drawers are current student files; there is some room for expansion; the entire group of drawers are referred to as student files.
Growth Pattern:	About 5 files added per month, except at heavy period prior to school start-up in Fall when about 50 new forms are filed; file slowly growing in size.
Sequence:	Filed alphabetically, word-by-word, according to pupil's name
Activity:	Forms filed by school office staff on an as-needed basis, e.g. whenever a parent completes a form. Used as the basis to prepare student files and to request transcripts from transfer students. File is used to verify information on students which is not yet placed in student files or recorded in computerized system.
Updating:	File items transferred to current student files when created. These files are kept until student graduates or leaves, then file is transferred to inactive files.

Figure 4.7
File Analysis: Example 2:—Library/Media Center Order File

Name of File:	On order file
Alternate Names:	OOF; Order file
Location:	In acquisitions department on tables in middle of room
Forms in File:	On-order forms
Physical Description:	plastic file boxes dimensions: 5-1/8" x 13" x 18-1/2" ($75 each drawer) 4 drawers in 2 files 1-200 forms can be filed per drawer alphabetical file guides in files
Size:	Approximately 500 forms in file
Growth Pattern:	Approximately 50 forms are filed each week; an equivalent number are removed each week.
Sequence:	Alphabetical, word-by-word according to title
Activity:	As book are ordered, forms are placed into the files. Forms remain in file while materials are on order and until processing of the books has been completed.
Updating:	The forms in the file are updated with the material receipt date. The items are pulled from the file when an item has been processed.

CHAPTER 5
Processing Analysis

Task Analysis

Processing refers to the routines associated with preparation of inputs and the use of the outputs. It is important to understand the processing of the current system in order to evaluate its efficiency, and to ensure a complete understanding of the operation. Without this knowledge, it is not possible to revise the system processing to take advantage of computer-based designs.

There are a variety of methods which can be used to describe processing. One method is to use a narrative description. However, this technique can generate considerable text — and does not easily provide a "picture" of the processing task(s) under review. To get an overall picture of how the processing occurs, a more useful approach is to perform a task analysis. This analysis consists of generating a list of tasks associated with the process in sequential order.

A task analysis for the pupil enrollment portion of a student record system would include the following steps:

- Parent or guardian requests a blank enrollment form
- Parent or guardian completes the form
- The form is submitted to the school clerk
- The clerk checks the form for completeness
- The clerk verifies data in the document
- The clerk indicates the data has been verified and notes how the verification was conducted
- The clerk initials the form
- The form is placed in the "files to be created" folder

Similarly, a task analysis associated with the development of a school newsletter using a computerized word processing application would include the following tasks:

- Gather program information to be included in the newsletter
- Write copy for newsletter
- Input and edit newsletter copy
- Layout newsletter format
- Create original copy of the newsletter

- Produce the required number of copies of the newsletter
- Prepare newsletters for mailing
- Obtain or develop mailing list of parents and guardians
- Sort mailing list by zip code or other appropriate order
- Create address labels
- Attach labels and prepare for mailing
- Mail and distribute the newsletter

Flowcharting

A task analysis does not always provide a clear overall picture of the process or of the interrelationships among the tasks included in the process. A technique called flowcharting can help resolve these problems. Flowcharting is the process of successively dividing a complex problem into parts of progressively greater and greater detail, and representing this graphically. There are standard international symbols used for flowchart construction and there are a basic set of charting conventions. The basic set of flowcharting symbols is shown in Figure 5.1.

These symbols can be combined by using a set of generally accepted conventions that allow you to graphically describe a process. Figure 5.2

Figure 5.1
Standard Flowcharting Symbols

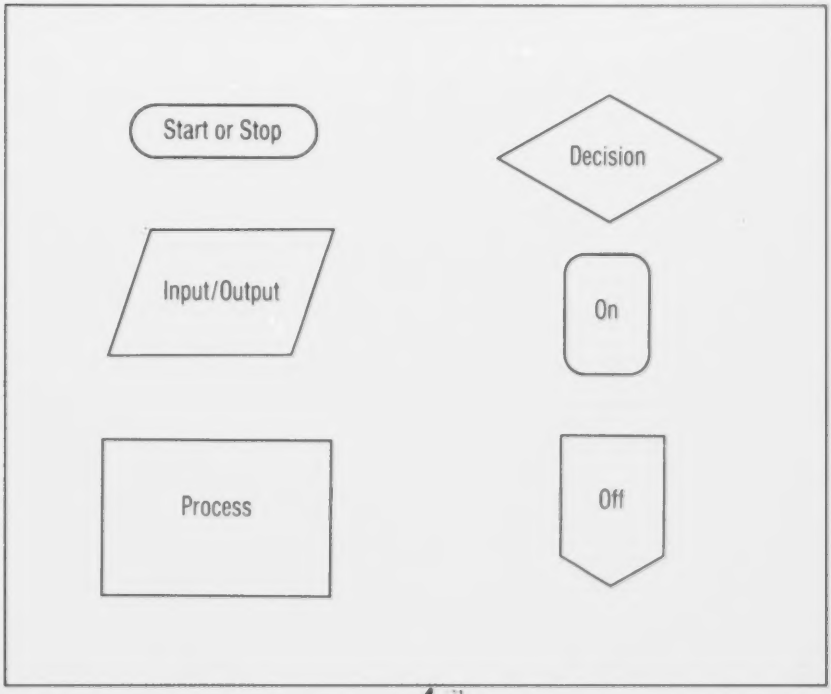
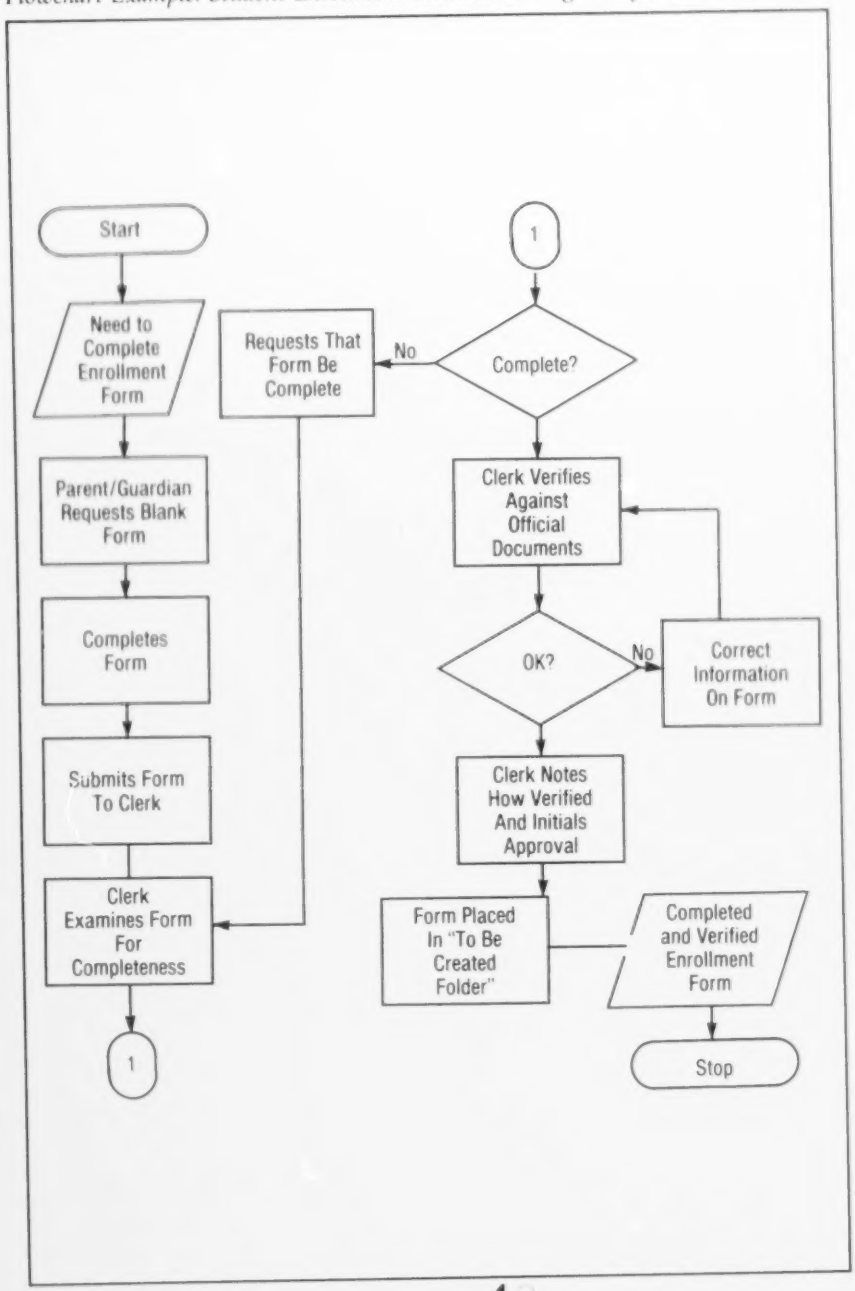


Figure 5.2
Flowchart Example: Student Enrollment Form Processing Analysis



Example 2
Creating a Simple Flow Chart

You can use flowcharts to help design computer applications for use in your daily work. Often working out the total process and interrelationship of various tasks before starting to develop the actual computer application will help you design an efficient and easy-to-use program with a minimum of errors and wasted effort in making changes.

Suppose you wanted to develop a simple Lotus worksheet to help determine which Library/Media Center issues were most in need of a computer application. This is the worksheet we developed in Example 1. Even with a relatively simple worksheet like this, using a flowchart to lay out all of the processes you want to capture on the worksheet can be very helpful.

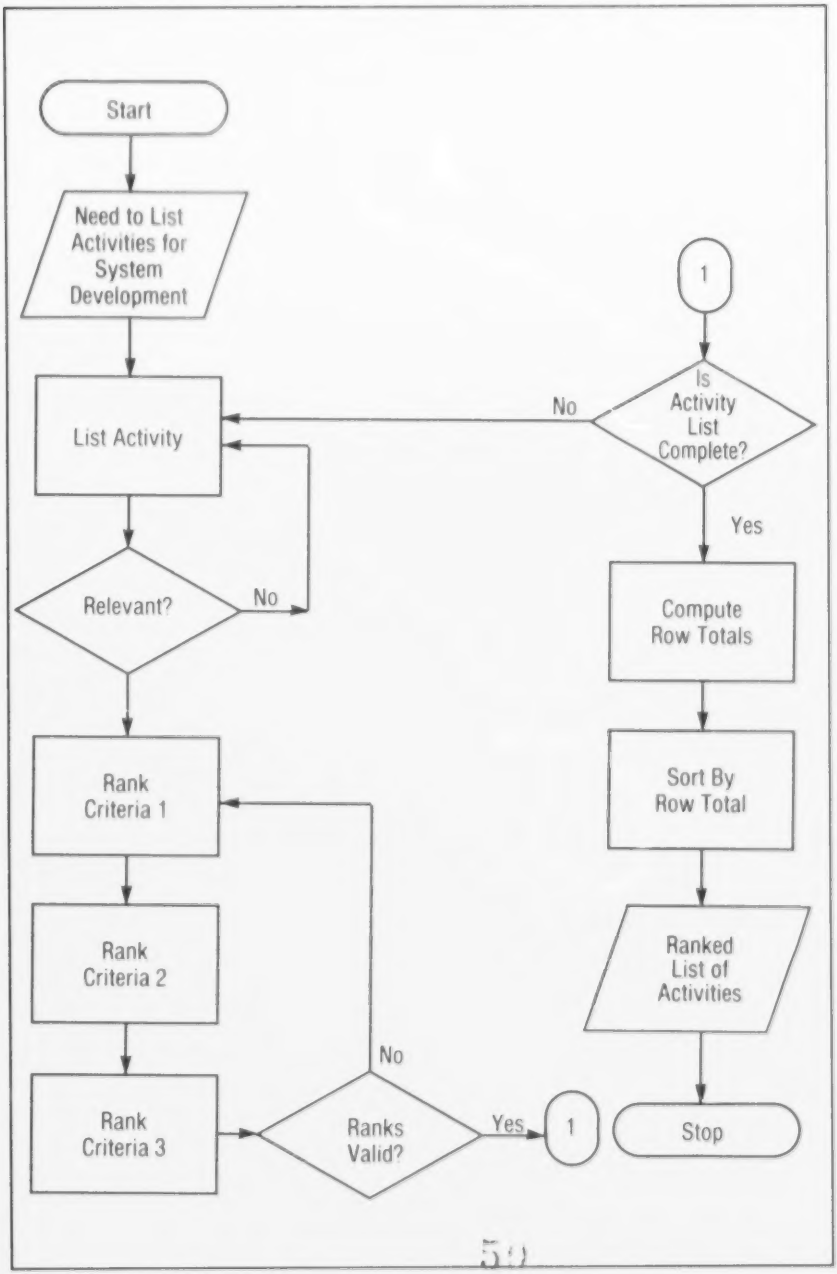
Start by thinking about the process you would use to replicate the process described in Chapter 3 to determine which Library/Media Center acquisitions issues would be most amenable to a computer solution.

The first step would be to identify the activities that are currently part of the process. Once an activity has been listed, it needs to be ranked in terms of the three criteria that you've established. Remember, the three criteria and the meaning of their ranks are:

1. *Information processing needs*
   0 - Not applicable
   1 - Low processing needs
   2 - Medium processing needs
   3 - High processing needs
2. *Retrieval Problems*
   0 - Not applicable
   1 - No problems
   2 - Minor problems
   3 - Major problems
3. *Repetitive clerical routines*
   0 - Not applicable
   1 - Few routines
   2 - Medium level
   3 - High level

Once all of the activities have been listed and ranked on the basis of your three criteria, you need to compute the total score for each activity and then determine which activity should receive our initial attention or development of a computer application. Figure 5.3 shows one solution to this problem.

Figure 5.3
Sample Flowchart for Lotus 1-2-3 Model of Library/Media Center Acquisition



shows a flowchart of a task analysis for the Pupil Enrollment Form Process outlined above. See how the flowchart makes it possible for you to quickly get an overview of the total process and follow the interrelationships of the tasks. Example 2 shows how flowcharting can also be used to help develop a specific computer application.

Summary

The processing phase is crucial to systems analysis and design. During this phase, the tasks which our application will perform are described in detail. There are a number of systems techniques that can be used to assist in this phase, flowcharting is one of the most useful of those techniques.

CHAPTER 6
Alternatives and Applications

Once you have developed an understanding of the system needs for the current operation, you are ready to examine automation options. These options could include a simple redesign of the present system using manual processes or the use of a technology, such as micrographics. However, the only option we will consider here is the computer.

In the past, computer options available to school business administrators for automating the functions of the business office were limited and the administrator could easily identify all of the available systems in the marketplace.. This is no longer the case. Today's marketplace is extremely dynamic with a vast number of hardware and software options available to administrators. The issues which must be considered in selecting hardware and software are discussed below.

Hardware

Hardware options are divided into three categories: mainframe computers, minicomputers, and microcomputers. Mainframe computing is characterized by on-line processing typically distributed over a large area. Mainframe computers operate as multi-user and multi-application systems, they are expensive, and they need a controlled environment. Educational time-sharing services, or educational computing service bureaus, typically operate on mainframe computers. Individual clients (schools) access and use the system through computer terminals which interface with the mainframe located at a remote site.

Minicomputers, like mainframes, operate in an on-line mode, are multi-user, and require a controlled environment for the hardware. But unlike a mainframe, minicomputers tend to be dedicated to a specific in-house application, such as school administration, and are housed on-site. Their cost may be within the realm of acceptability for large schools and school districts.

Microcomputers differ from the other two categories of computers because they can operate in a regular office or school environment, are relatively inexpensive, and until recently, are single-user oriented. However, developments in microcomputer hardware and in telecommunications have allowed microcomputers to emulate the power and sophistication of

larger systems, particularly the minicomputer. This has occurred through such developments as distributed processing where microcomputers are linked to minis and/or mainframes, and because of the development of local area networks (LANs) where individual microcomputers are linked to share software, data, and peripherals. Today, with increased memory, storage capacity, and processing speed available in microcomputers, it is difficult to make a clear distinction among these three categories of computers.

Software

Educational administration software facilitates the creation, manipulation, retrieval and reporting, and maintenance of data appropriate for the operation of a school or school district. This broad definition includes applications in many areas of educational administration, including student records, personnel records, finance and budgeting, management planning, cafeteria, and physical plant management.

While it is possible to categorize the software marketplace by application area, recent trends in integrated systems design sometimes makes this approach difficult. Integrated software packages are those that provide multiple computing functions in one program. For example, an integrated package may contain a word processing program, a spreadsheet, and a database manager. The advantage of an integrated package is that the various components are usually able to share files, making data transfer from one application to another easier.

It is also possible to identify software by the type of hardware on which it operates — mainframe, minicomputer, or microcomputer. However, we are currently witnessing the migration of software from smaller to larger systems, and vice versa. Thus, some software operates on a wide spectrum of hardware and also across hardware manufacturers.

Another way to categorize software is by type, that is, the functions the software performs. Using this approach, educational administration software can be categorized as: work-enhancement software; database software; subsystem application software; and integrated software.

Work-enhancement software facilitates office productivity; it is very popular and mostly microcomputer-based. Included in this category are: word processing programs, such as WordStar, Multimate, Word and WordPerfect; spreadsheet packages, such as Lotus 1-2-3, Excel and Quatro; time management software including Harvard Total Project Manager; graphics programs such as Chart and Harvard Graphics; communications software which allows access to other hardware, software, and data; and integrated work-enhancement packages, such as Framework, Works and Symphony, which combine some or all of the above functions in one package.

Since so many educational applications are database dependent, this category is given special attention here, even though in strictest terms database software could be considered work-enhancement software.

Database software can be a list or file manager, such as Ashton-Tate's RapidFile and PFS:File, which allows for the creation and manipulation of single, unrelated files. Text retrieval software, such as Inmagic, provides quick indexing of database records and individual words in those records.

Database management software (DBMs) is more complex in that it allows flexibility among fields and files. In a relational data base manager, the relationships of data in separate files can be established as needed, rather than at the design step as is the case of a file manager. Examples of DBMs include PARADOX, dBASE III+ and dBASE IV.

The sub-system application software available in the marketplace is designed to automate a single administrative function. Examples include, School Attendance Manager and Schoolworks: Athletic Director. Typically these applications are developed using a higher level programming language, such as BASIC, COBOL or C. Sometimes a general purpose DBMs package is used to create standardized record structures, screen displays, and report formats, with programming provided so the user can take advantage of the full power of the DBMs package, without learning all of its complexities.

Many schools would like to automate a number of application areas, and/or have commonality (such as with user access, data files, and maintenance) across these application areas. Other districts elect to automate a single application leaving integration of additional application areas for consideration at a later date. There are a growing number of products in the marketplace which have this "modular" capability. Such software is known as integrated software and includes such examples as SCHOOLMASTER and INNOVAK.

Appendix 1 describes some of the available educational administrative software.

Summary

Prior to selecting a microcomputer system, one should examine the alternatives available in the marketplace. The large number of systems currently available can be categorized in a variety of ways. We have used four categories—enhancement, database management, single application and integrated systems—to describe the options available to school administrators.

CHAPTER 7
Selection

Up to this point, the systems analysis has included: problem definition, input/output and processing analysis, and a review of alternative software application designs. Now you are ready to review available software to determine whether or not it meets your needs as outlined through this preliminary analysis. Ideally, once a software selection has been made, appropriate hardware should be selected. Although this is the ideal approach, hardware is frequently already available and, therefore, software selections must be limited to those that operate on existing hardware systems.

This chapter will review the software and hardware marketplace, and examine the specific software and hardware elements that should be considered when comparing alternatives. System selection options will be described for both the student records and scheduling system and the Library/Media Center applications introduced in Chapter 3.

There are many software producers and hardware manufacturers competing for your school district's business. Selection is not always an easy process, however, there are some basic guidelines which can be used to review your software and hardware options. The points outlined in Figure 7.1 should be considered in software and hardware selection.

Selection Sources

Once you understand your needs, you can begin to explore the marketplace. Most likely the first thing you will notice about the marketplace is the vast number of products available, and the confusing system requirements associated with each. Sorting through all that is available can be a difficult and time-consuming process. Fortunately, there are a number of sources which may be helpful in determining what software programs are available for your application needs. These sources include:

- *Directory of Information Management Software for Libraries, Information Centers, Record Centers*. Pacific Information Inc., 979 Eaton Drive, Felton, CA 95018; 1983-Annual.
- *Educational Software Selector* (TESS). 1986-1987 Edition and 1988 Supplement. EPIE Institute, P.O. Box 839, Walter Mill, NY 11976; 1986-1991.
- *Microcomputer Index*. Learned Information, Inc., 143 Old Marlton Pike,

Figure 7.1
Guidelines for Software/Hardware Selection

Characteristics of the Vendor/Producer

- Business reputation
- Length of time in business
- Knowledge of education and schools
- Number of schools or school districts currently using the product
- User references
- Support services available from the vendor and from third parties
- Geographic base of installations
- Vendor accessibility by telephone
- Other services provided

Quality and Characteristics of Training

- Software and hardware documentation (ease of use and clarity)
- Availability of training classes
- Availability of self-paced computer-based training packages
- Ease of learning the software

Costs

- Understand all costs involved including: installation; training; maintenance; and upgrades
- Conduct cost comparisons among available systems

Software Selection Issues

- Log-on procedures
- Loading time
- Response time
- User friendliness
- Screen displays
- Ease of procedures/commands
- Ease of data entry
- Ease of deletions/adds/changes
- Flexibility of format
- Searching ease
- Quality of system output
- Error messages
- Security measures
- Back-up procedures
- Customizing features
- Usage tracking
- File size capabilities
- Program size
- Equipment compatibility
- System/organizational compatibility
- Expandability
- Compatibility with future versions of the product
- Integration with future applications

Hardware Selection Issues

- Hardware reliability
- Warranty
- Servicing procedures
- Response time
- Software compatibility
- System/organizational compatibility
- Upgrading options
- Ergonomic design features

Medford, NJ 08055; 1981-current (This is also available on-line as File 233 on DIALOG).

- *Software for Schools: A Comprehensive Directory of Educational Software.* New York: R.R. Bowker, 1987-88.

In addition, there are many other general sources you can review for assistance in hardware and software selection. Among them are a series of publications from Datapro Research Corporation (Delran, NJ). They include:

- Datapro-McGraw Hill Guide to Apple Software
- Datapro-McGraw Hill Guide to CP-M Software
- Datapro-McGraw Hill Guide to IBM-PC Software
- Datapro Directory of Microcomputer Software
- Datapro Directory of On-line Services
- Datapro Reports on Microcomputers
- Datapro Reports on Minicomputers

Other useful sources include catalogs from educational computer software and hardware distributors.

Popular microcomputing journals, such as *BYTE*, are excellent sources of information on software and hardware. Some general purpose microcomputing journals, such as *InfoWorld*, periodically review hardware and software. These journals frequently rate hardware and software on the basis of performance, documentation, ease of use, error handling, and support. They are also a good source of information on what software and hardware will be available in the near future.

Journals directed towards specific hardware provide another source of excellent information and reviews. *PC World* devotes special issues to an annual hardware review and to an annual software review. These special issues of the journal provide a comprehensive guide to the hardware or software for IBM Personal Computers and compatibles. *Incider: The Apple II Magazine* provides a similar focus for Apple II hardware and software, while *Mac User* and *Mac World* offer this information for Macintosh systems. Additionally, periodicals specifically oriented towards use of computers in schools occasionally include information on administrative applications. These include publications such as *The Computing Teacher* and the *AEDS Journal*.

Perhaps the most important source of information, however, is other school administrators. One of the best ways to ascertain the strengths and weaknesses of any software/hardware combination is to ask someone who is already using it. Talk to your colleagues in other districts to see if any of them have found an application that meets their needs, and would be well-suited to meet the demands of your district as well. Ask if others have considered the software program you are considering. If others have considered and rejected it, find out why. Was the program inadequate to meet their needs? Was support for the program weak? What didn't they like about the program, and why did they select a different one? If another district is using the program you are considering, ask them about that program's strengths and weaknesses. Ask if you can visit their district and

see the program in operation. One of the best ways to determine whether or not the program will work for you is to see how well it is working somewhere else.

Hardware and Software Selections

Armed with your knowledge of information sources and your review of selection criteria, you are ready to begin choosing specific hardware and software for your application. In earlier chapters several examples illustrated the steps involved in conducting a systems analysis. These examples included components of a Student Records module, and components of a Library/Media Center application. Both of these examples will be used in the discussion of hardware and software selection.

Selection Application 1—Student Records and Scheduling System Requirements

Previous analysis established that the student record and scheduling application has the following objectives:

- Input records and updates interactively
- Retrieve immediate responses to information queries on individual students, teachers, and class schedules
- Generate, on demand, student record and schedule reports including master student lists, master class schedules, teacher and homeroom lists, reports, address labels, and a variety of statistical summaries
- Establish an improved student record and scheduling system which will not increase costs

Further analysis revealed the following functional requirements for a student record system[1]:

- The system must handle a total district enrollment file of 2,500 records with 400 new records or updates per year
- The system should connect each school site (five elementary schools, one junior high, and one high school) and district headquarters into a networked system
- The system must handle an average of 50 new student records per school at registration time, and an average of 5 new records per school per month during the rest of the year
- The system must handle an estimated 250 queries and 25 record updates per day
- The system should have the ability to produce reports for individual schools

Input Requirements and Data Dictionary

The detailed input requirements for the application are generated from

[1] It should be noted that other modules in a student system, such as scheduling and grade reporting would have their own, additional, requirements — these are not stated here.

the results of the input analysis discussed in Chapter 4. The forms input analysis provides the characteristics of the data which will be the system's inputs. In applications which involve the creation of databases, which many systems require, this step typically includes creation of the data dictionary.

A data dictionary is a list of all the data elements in the system, and each element's characteristics and special features. Figure 7.2 provides an example of an input requirements list and data dictionary for one file in the student system: the student record file.

Typically, the first field of data in a computer record is an identification number. This number serves as a common retrieval key, and the data are generally sorted by this field. The remaining fields of data should appear in a logical order. For example, address data should appear in the sequence of a traditional mailing address.

The Marketplace

The listing of requirements for this application indicates that there are a number of modules, such as student record and scheduling, which are integral to the automation effort. Consequently, any investigation of software should examine packages which provide all of these components, and which offer them in an integrated approach.[2]

Our review of the educational administration software marketplace identified a number of packages for consideration. Among them are PSI STUDENT/3000 and Educational Timesharing System (SASI).

Some of the packages have been used successfully in other schools. Additionally, through our review of the education literature, discussions with other school administrators, and interviews with data processing personnel, it appears that development of an in-house system would not be a cost-effective option. Development costs would be high, the time needed to design, develop, and implement the application would be considerable, and there is no guarantee that the end result would be better than existing, commercially available software.

Therefore, a more detailed review of available software packages is appropriate. At this time we have not imposed any constraints regarding a specific hardware platform for the system. Obviously, there are cases where a district has established a policy mandating the use of one hardware option. The reasons for this might include existing staff familiarity and expertise with that hardware, a need for data compatibility among applications which is simplified by maintaining a consistent hardware platform across all users, or the desire to simplify integration with existing hardware. For example, a policy to utilize IBM or compatible hardware would eliminate a number of popular student management systems which operate on Apple II or Macintosh computers. However, at this point, our system

[2] Note that the student record files used as an example in this book is only one of several files which would need to be developed for this application.

hardware options are open, and we should review all the alternatives that meet our functional requirements.

Discussion

By reviewing the literature, attending educational conferences and exhibitions where systems are discussed or displayed, and holding discussions with other administrators you should be able to locate those software options which meet your general system requirements and eliminate those which do not meet your needs. This will enable you to reduce the total number of software packages that you need to review more carefully. Using the evaluation criteria developed earlier in this chapter, you can review each package to see which is most likely to meet your needs.

By using this approach, Evaluators establish both a level of importance and a rating for each criterion. The score for each criterion item is derived by multiplying the rating by the level of importance. The scores are added to arrive at an overall rating for the software/system. The higher the overall

Figure 7.2
Student Records File Data Dictionary

Field Number	Description	Length	Alpha/ Numeric
1	Student number	9	n
2	School number	3	n
3	Grade	2	n
4	Sex	1	a
5	Name	25	a
6	Social Security number	9	n
7	Street	33	a
8	City	20	a
9	State	2	a
10	Zip code	9	n
11	Home phone	12	n
12	Emergency phone number	12	n
13	Birth date	6	n
14	Birthplace	25	a
15	Parent or guardian (male)	25	a
16	Occupation	20	a
17	Employer	25	a
18	Employer phone/address	25	a
19	Birthplace	25	a
20	Citizen of	25	a
21	Parent or guardian (female)	25	a
22	Occupation	20	a
23	Employer	25	a
24	Employer phone/address	25	a
25	Birthplace	25	a
26	Citizen of	25	a

rating, the more appropriate is the software/system option for further review. An example of a completed Software/System Evaluation Form with data from a hypothetical system is displayed in Figure 7.3.

Using this approach, a review is undertaken of the possible software options. In addition, some vendors, such as Century Consultants Ltd. (CCL STARS), offer worksheets which a school can use to outline its requirements in a standardized format. Vendors can review the data on system requirements and determine whether their system offers the desired features. These processes help reduce the possible options to a final group of candidates which then can be reviewed in more detail. Reviews of the final candidates could consist of on-site software demonstrations, use of test software and files by school personnel, and visits to other sites where the software is presently installed. Criteria, in addition to that used in the previous software evaluation, should be established to standardize the comparisons of the final software options. These criteria might include

Figure 7.2
Student Records File Data Dictionary (Continued)

Field Number	Description	Length[1]	Alpha/ Numeric[2]
27	Parent or guardian (female)	25	a
28	Language at home (if not English)	15	a
29	Last school attended	25	a
30	School address	64	a
31	Grade attended previously	2	n
32	Last date attended	6	n
33	Names of sisters and brothers	50	a
34	Ages	25	n
35	Ethnic code	1	n
36	Verified	1	n
37	Source	1	n
38	Initials	3	a
39	Today's date	6	n
40	Homeroom or teacher number	4	n
41	Enrollment date	6	n
42	Special program enrollment	3	n
43	Locker number	4	n
44	Transportation code	3	n
	Total	**702**	

[1] Length refers to the number of characters that are reserved in the system to store the data for each field.

[2] Alpha/numeric refers to the type of data to be displayed in the field. Alpha fields can only hold numbers or digits, while numeric fields can contain any combination of digits and letters. This distinction is important in a database because arithmetic calculations can only be computed on numeric fields.

specific technical, performance, maintenance, and cost requirements in addition to the functional requirements already delineated. Technical requirements include those related to hardware, software, and database construction. Examples include:

- The hardware be state-of-the-art
- The system be of modular design to allow future upgrades and integration of additional applications
- The software allow for migration to larger hardware systems
- The programming language for the system meet industry-wide standards
- The system provide for error detection, data protection and security

Performance requirements refer to the ability of the system to meet various acceptance tests. Acceptance tests can consist of:

Figure 7.3
Software/System Evaluation Form

Name of Software/System: System X
Overall Rating: 232

	Level of Importance	Rating	Score
Vendor/Producer			
Reputation	3	2	6
Length in business	1	2	2
Knowledge of education/schools	3	3	9
User base	2	1	2
User references	3	3	9
Support Services	3	2	6
Geographic base	1	1	1
Accessibility by telephone	3	2	6
Response to product	3	2	6
Training			
Documentation	3	1	3
Training classes	3	2	6
Computer-based training packages	1	1	1
Ease of learning	2	3	6
Software			
Long-on procedure	1	1	1
Loading time	2	1	2
Response time	3	2	6
User friendliness	3	2	6
Screen displays	3	2	6

- Length of time to learn to use the software
- Time to input sample records
- Ability to handle a number of jobs simultaneously
- Time to retrieve sample searches
- Time to display search results
- Time to print reports
- Time to index or sort the database files
- Disk and memory space required for sorting and indexing
- Speed of importing and exporting data
- Maintenance time, such as time to perform back-up procedures
- Time to resolve errors
- Response time degradation as more users are placed on the system
- Vendor response time to questions and to fix problems.

Figure 7.3
Software/System Evaluation Form (Continued)

Ease of procedures/commands	3	2	6
Ease of data entry	3	2	6
Ease of deletions/adds/changes	3	2	6
Flexibility of format	2	2	4
Searching ease	3	2	6
Quality of system output	3	3	9
Error messages	3	1	3
Security measures	3	3	9+
Back-up procedures	3	1	3
Customizing features	3	2	6
Usage tracking	2	1	2
File size capabilities	3	3	9
Program size	1	2	2
Equipment compatibility	3	3	9
System compatibility	3	3	9
Hardware			
Hardware reliability	3	3	9
Warranty	3	2	6
Servicing procedures	3	2	6
Response time	3	2	6
Software compatibility	1	3	3
System compatibility	3	3	9
Upgrading options	2	3	6
Ergonomic design features	2	3	6
Costs			
Cost clarity	2	2	6
Cost comparison with other systems	2	1	2

Maintenance requirements specify the type of on-going support which will be provided, and the manner in which software and hardware fixes should occur. Cost requirements relate to price reporting in terms of specific hardware, software, maintenance, services, training, shipping, and installation, as well as price protection guarantees.

You need to determine which of these requirements are mandatory, and which are optional. The system will not be accepted without meeting the mandatory requirements, while the optional requirements are desirable, but not absolutely essential.

In addition, your requirements may change over time. Thus, it is appropriate to establish requirements for today, but also to delineate the kinds of requirement changes that should be considered in the next three to five years. This might include such factors as a projected student body increase or decrease, or changes in school organizational structure. Examples of additional requirements which could be used in a system selection include:

- Ability to process two jobs simultaneously
- Maintaining an average response time of less than 5 seconds per inquiry, and less than 20 seconds during peak load times
- A maximum of 15 minutes to schedule 500 students
- The ability to handle a projected student body increase of 20 percent in three years
- All hardware must be delivered and installed within 180 days of contract signing

Selection Choice

Once the candidate systems have been compared, a final selection can be made. The reasons for choosing a particular system may vary from application to application, but might include the following:

- It received the highest rating on our Software/System Evaluation form
- It best meets our functional requirements
- It meets all of our technical and maintenance requirements
- Its performance met our requirements by meeting or exceeding our benchmark acceptance test levels
- It is highly rated by other users
- Our site visits were positive; users at these sites rated the system highly in terms of functionality and performance
- System costs for hardware and software are within our established cost framework
- The system was rated as "one-of-the-best" by an independent evaluation team from a professional education association
- The system provides an interactive, state-of-the-art user interface with the ability to meet our future growth needs

Formal Procurement Process

Sometimes, state laws or local district policies require a formal procurement process for the acquisition of an automated system. Formal procedures are usually required if the system cost exceeds a certain threshold. Often, districts elect to use a formal bidding process to help ensure a fair selection among competing alternatives.

Although there are a number of different formal procurement approaches, the most common include Invitations for Bid (IFB), Request for Proposals (RFP), and a Sole-Source Bids. An IFB invites potential suppliers of an automated service to bid, with the purpose of identifying the bidder who can meet the minimum requirements at the lowest cost. The agency must enter into a contractual arrangement with the minimum bidder.

An RFP is similar but allows the agency to negotiate aspects of the requirements with the most competitive bidder(s). A sole-source bid is used when there is only one vendor who can meet the automation requirements. Sole-source is an unlikely approach since the current school automation marketplace consist of a number of vendors who can meet many, if not all, of the automation requirements specified by a school. The RFP is the most common of these procurement practices. The information typically found in a RFP is shown in Figure 7.4.

Selection Application 2—Library/Media Center System Requirements

Our analysis determined that the Library/Media Center application has the following basic objectives:

Figure 7.4
Contents of a Typical RFP

Introductory Section:	Background information on the School; rules and conditions regarding the RFP; schedule of activities; definition of special terminology used in the RFP.
Information Section:	Instructions to vendors covering such topics as number of references required, the RFP evaluation process, and RFP rejection process.
Special Requirements Section:	Proposal guarantee and validity period; regulations regarding news releases; procedures for staff training; types of documentation provided.
System Specification Section:	Detailed descriptions of the functional, technical, performance, and maintenance requirements.
Financial Section:	Price reporting methods; price guarantees.
Contract Section:	Contractual requirements.

Figure 7.5
Data Dictionary—Teacher/Administrator File

Field #	Field/Data	Length	Numeric	Description
1	Identification Number	10	N	Social Security #
2	Last Name	20	A	
3	First Name	15	A	
4	Middle Initial	1	A	
5	Salutation	4	A	e.g., Dr., Rev., Hon., etc.
6	Level	1	N	*See codes below
7	Street Address	32	A	
8	City	20	A	
9	State	2	A	
10	Zip	5	N	
11	Zip +4	4	N	
12	Input Date	6	N	Mo/Da/Yr
	Total	**120**		

* 1 = teacher; 2 = administrator; 3 = other credentialed; 4 = other

Figure 7.6
Data Dictionary—Material File

Field #	Field/Data	Length	Numeric	Description
1	Material Identification Number	5	N	Accession number
2	Title	120	A	
3	Author(s)	120	A	
4	Place	30	A	
5	Publisher	30	A	
6	Date	4	N	Publication year
7	Physical Description	30	A	Pagination, etc.
8	Call Number	15	A	Dewey or Lib. of Congress
9	Subject(s)	120	A	
10	Notes	60	A	
11	Dates of Availability	6	N	Mo/Da/Yr
	Total	**540**		

- To create and maintain a faculty name/address file
- To create a materials file of new additions to the library
- To maintain this new additions file
- To create a periodic report on new materials and distribute this in the Library/Media Center
- To generate a selective mailing of this monthly report, e.g. to teachers and administrative personnel

Further investigation of this application revealed the following functional requirements:

- The system must have the capacity to handle a faculty file of 200 records and a minimal number of updates per year
- The system must handle a Library/Media Center data base of 1,000 records; approximately 900 new items are added per year

Input Requirements and Data Definition

Using the results of the input analysis, the input requirements and data dictionary for the Library/Media Center application were generated. The data dictionary for the teacher administrator file is displayed in Figure 7.5 and the data dictionary for the material file is shown in Figure 7.6.

The Marketplace

On the surface the Library/Media Center application does not appear to be too complicated. However, a number of issues must be addressed before the system can be successfully implemented. Recent developments in the area of national standards for bibliographic data (MARC) and the formulation of bibliographic utilities (OCLC) make it possible for a Library/Media Center to have on-line access to existing data bases containing bibliographic records for catalog database creation and for interlibrary loan purposes. Any Library/Media Center automation plan should consider these developments.

Presently, the Library/Media Center in our example does not access either one of these systems, but there is a long-range plan to do so. Additionally, a Library/Media Center application requires a file conversion effort (retrospective conversion) to place existing bibliographic records into machine readable form. This task is also part of the long-range plan for Library/Media Center automation. The current need is to create the new materials Information Bulletin before implementing the Library/Media Center long-range plan. However, current automation efforts should be planned to interface with future developments.

An examination of the marketplace indicates that there are a number of microcomputer software packages which have been specifically designed for Library/Media Center automation. Some of these packages have been developed to operate on Macintosh hardware, and can be used for automating such functions as catalog card production, circulation overdue notices, and media booking. Examples of such packages include: MacCards, CALM,

and Right-On Programs. However, there are no programs in the marketplace which specifically meet our application needs. Our review of the literature indicated that general purpose database management software (DBMs) packages, such as dBASE III+ and Inmagic, have been used for a number of library automation applications. Additionally, we realize that our application is amenable to a classic DBMs solution.

Discussion

There are a number of DBMs packages operating on a variety of hardware that meet our basic requirements for the Library/Media Center application. However, through our continued review we have determined the following additional information:

- The majority of microcomputer hardware used in other local school administrative applications (and for some instructional applications) in our district are IBM or IBM compatible
- There has been discussion of the development of a local area network (LAN) based on the IBM-PC or compatible environment
- The cost range of IBM or compatible hardware (with an educational discount) is acceptable
- The IBM or compatible hardware capacity can be easily increased, i.e., adding more memory and/or disk storage
- There are a number of reliable hardware manufacturers who are likely to stay solvent
- There is a current movement to replace existing dot matrix printers with laser printers for administrative applications.
- dBASE III+ is a popular package and there is a core of individuals in our school who are already familiar with this package
- There is a large user base for dBASE
- Reviews of dBASE have been satisfactory
- The package has been upgraded recently
- There is a desire to select packages which can be used for other applications, thus non-library/media specific software is desired
- dBASE has been used by other libraries/media centers for developing applications
- There are excellent disk-based tutorials for training on this package
- Most commercially available, library/media-specific software packages have limitations on record and field size, and do not meet our specific needs

Processing

In the preceding section, we concluded that the best system choice for our Library/Media Center application is an IBM-PC or compatible system using dBASE III+. The next step is to outline our processing needs. This normally consists of the following activities:

- Detailing the processing requirements unique to our microcomputer application, e.g. the record and file sizes

- Establishing other microcomputer processing requirements, e.g. disk space for storage of files and indexes

Previously we determined the characteristics of our data and prepared the data dictionary for both the teacher/administrator file (Figure 7.5) and the material file (Figure 7.6). The total number of characters in each file will establish the general record size for each file: 120 characters for the teacher/administrator record and 540 characters or bytes for the material record. Our file analysis indicated that the teacher/administrator file is 200 records with a static growth rate; the material file will start with 500 records and will have a growth and deletion rate of approximately 50 records a week.

Since the system will be microcomputer-based we need to know how much disk storage space will be required for the specific application. Will our application work on a floppy disk-based microcomputer[3], or do we need a hard-disk based system? If we need a hard disk, what size hard disk should be considered?

To determine the size of our application file, we multiply the size of each record times the total number of records in the file. In our example, this would amount to 240,000 bytes (120 bytes/record x 200 records) for the teacher/administrator file, and 270,000 bytes (540 bytes/record x 500 record) for the material file. In addition, we should include future growth estimates into our estimate of the projected file size.

The growth pattern of the two files discussed in this example are fairly static. However, other files may have vastly different growth patterns. A library/media catalog which contains entries for all of the library's holdings would continue to grow over time. For example, a library/media catalog which had 2,000 records each consisting of 500 bytes to which 100 items are added every three months would grow much more rapidly. Figure 7.7 shows the growth patterns of these three different file types.

Our estimates of the file size for the two Library/Media Center files indicate that a standard 360kb floppy disk will not provide sufficient storage space. While we might consider using A 1.2MB floppy disk system, there are a number of good reasons for choosing a hard disk configuration instead. In addition to the increased storage space that is available, hard disks can significantly speed up processing time. In general, computers are able to read and write files to a hard disk faster than they can to a floppy disk. Moreover, in addition to storing your data files on a hard disk, you can also store application software programs such as dBASE III+ on the hard disk, significantly increasing access time as you shift between programs. Finally, many microcomputer applications require additional storage

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[3]There are a number of different floppy disk mediums available today. IBM and compatible microcomputers can use 5-1/4" floppy disks which store either 360k bytes or 1.2 megabytes of data, or 3-1/2" floppy disks which store either 720 bytes or 1.44 megabytes of data. Macintosh computers use 3-1/2" floppy disks that either store 800k bytes or 1.44 megabytes of data.

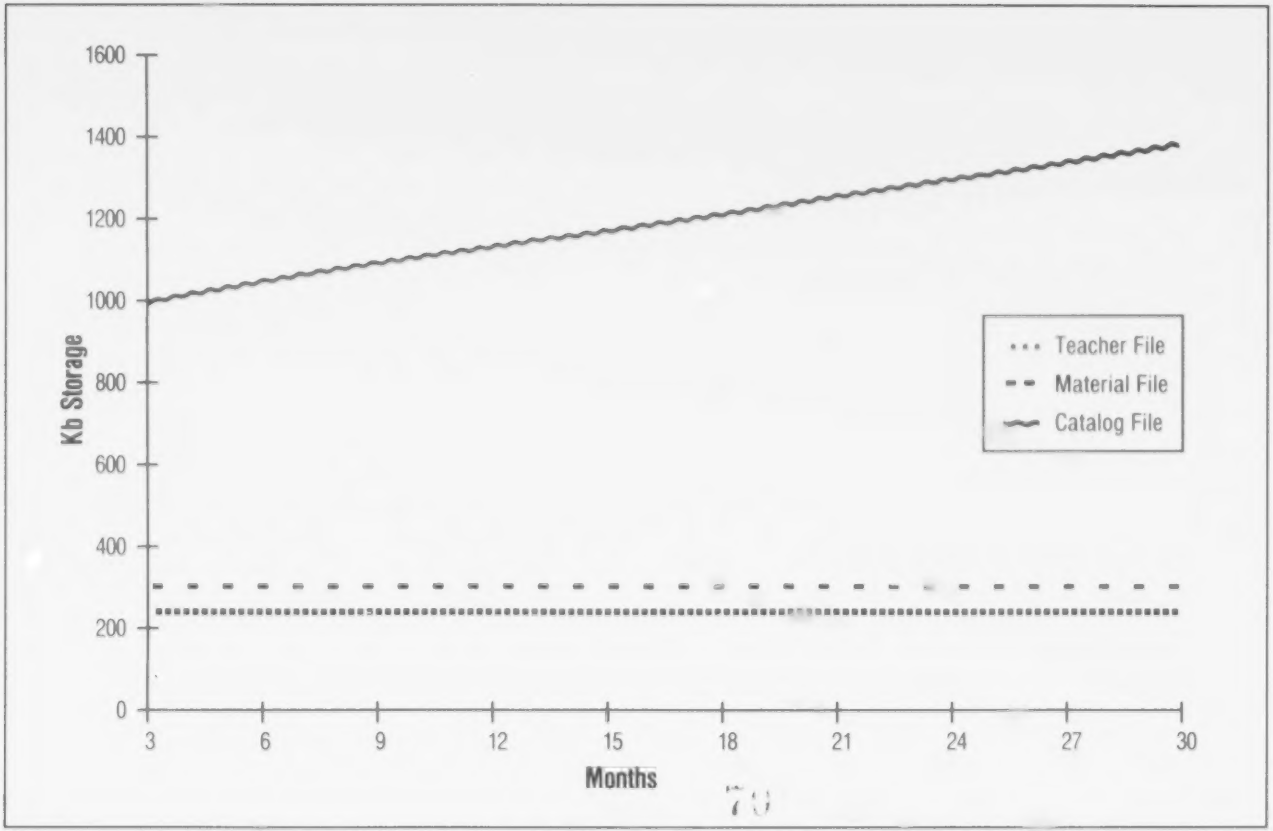


Figure 7.7
Growth Patterns of Different File Types

space for their files.

In addition to the characters identified in our data dictionaries, a DBMs system will also keep information about the file, either in the data file itself, or in a group of related files. Finally, if you use dBASE III+, and choose to index or sort your database, dBASE will create a series of sort and index files that you can use to sort the file again in the future. While this is a very useful feature, the index files require disk storage space as well. A common practice is to allocate storage space double that of the estimated file size.

You will also need to decide what level CPU you want to include in your system. Currently, IBM-PC s and compatible machines come in a wide variety of CPU and processing speed combinations. While the differences are fairly technical, and sure to change in the future, there is a direct, positive relationship between CPU level and cost, as well as a similar relationship between processing speed and cost. You have to decide how important faster processing time is to you, and how much you are willing to pay for that speed.

If your data base will contain a relatively small number of records, an early generation CPU such as the Intel 8088 or 8066 running at a relatively slow clock speed of 8 megahertz may be adequate. However, if your database is very large, say 10,000 records, and you have to sort that database on a number of characteristics frequently, you may want a system that will run faster. In addition, you may want to consider a newer generation CPU such as the Intel 80386 or 80386SX to give you more flexibility in the future, both in terms of processing capabilities, and because future software upgrades may require the more sophisticated CPUs.

There are many complex decisions that must be made regarding hardware capability; just remember that there will always be a trade-off between price and performance. The decision regarding how much you should spend to improve the system performance should be based on current and projected processing needs, and the level of resources available for the project. Your funds may be better spent teaching staff to use a slower machine, since even the fastest computer in the world will only respond as fast as the human operating it can give it instructions. Getting the most out of what your computer can do is very important.

Also remember that in this day of rapid technological growth, computers seem to be obsolete almost as soon as you purchase them. Don't put off a purchasing decision because of this; remember that as long as your computer is doing what you need it to do, it is not obsolete.

Choice

After conducting an analysis of the system needs for our Library/Media Center application, we can put together a specific list of the hardware and software needed to make the system operational. This list would look something like the following:

1. An IBM-PC or compatible computer, with either a 80286 or 80386SX CPU, and 1MB of memory

2. A 30MB or larger hard disk
3. A 3-1/2" diskette drive, and a 5-1/4" diskette drive if other computers in the school use that format and file sharing is anticipated
4. The latest version of the DOS operating system
5. A DBM application program such as dBASE III+, dBASE IV or PARADOX.
6. A word processing package to facilitate additional uses of the computer, possible choices include WordStar, WordPerfect or Word

This example was based on an IBM or compatible model because of the constraints described earlier. However, if those constraints were relaxed, or if your school has already made an investment in Macintosh computers, it would be possible to purchase a Macintosh computer and DBMs software to make the Library/Media Center system operate on that platform as well.

Depending on the hardware decisions you make, this system could be expected to cost between $3,500 and $6,000. In addition to these costs, you should expect to devote a considerable amount of staff time to system development, and to staff training in the use of the application. These costs are likely to be substantially higher than the hardware and software acquisition costs.

Summary

There is a wide range of hardware and software in the marketplace. A systems analysis approach will provide an excellent basis for making the best choice for your school environment. There are a number of points you should remember when making these choices. These include the characteristics of the vendor and manufacturer, the quality and characteristics of the training that is available, costs, the technical capability of the system, and availability of support for both the hardware and the software.

Many selection sources are available. Some are specific to schools and others are more general in nature. After careful consideration of the selection issues, a review of the selection sources, your own analysis of specific needs (such as outlining the data dictionary specifications), and a careful review of options, you can make an appropriate choice. Chapter 8 shows how to design the actual application that will operate on the system you choose.

CHAPTER 8
Design

This phase is the step in the system analysis model where the design of the automated system is specified. This is particularly detailed for an in-house developed system, such as our example of a Library/Media Center application.

In those instances where a commercially available software package is selected, the points made in this chapter regarding system design can be used in the selection process as criteria for additional requirements specifications—that is, points to consider while comparing alternative choices.

Typically, the design phase consists of five steps:

- Input forms design
- Input screen design
- Output design
- Development of user-cordial interfaces
- Processing

Each of these steps is discussed in more depth in this chapter.

1. Input Forms Design

The first step of the design process is to consider the development of the forms which will be used for data input. In some instances you may work from forms already in existence and no change is desired or possible. This frequently occurs in a file conversion of Library/Media Center catalog records. In our student record example, you may want to create new forms to gather data from parents or guardians.

When designing input forms, you should consider the following points:

- Data on form should be in logical sequence
- There should be adequate space for users to fill in the data requested on the form with either a pen or a typewriter
- Keep forms as simple as possible
- Use separate lines or different areas on the form for different types of data
- If needed, instructions should be provided on the form
- Place the name of the form on the top of the form
- Your organization's name should appear on the form
- The date the form was created should appear on the form

- Use color to highlight different parts of the form as appropriate (green and black on white provide the best contrast)
- If multiple copies of the form will be required, consider using multicopy forms with either carbons or NCR paper
- To simplify completion of the form, use check mark options as often as possible
- Use standard paper sizes for forms
- Make sure that the data element by which the form is filed appears at the top of the form

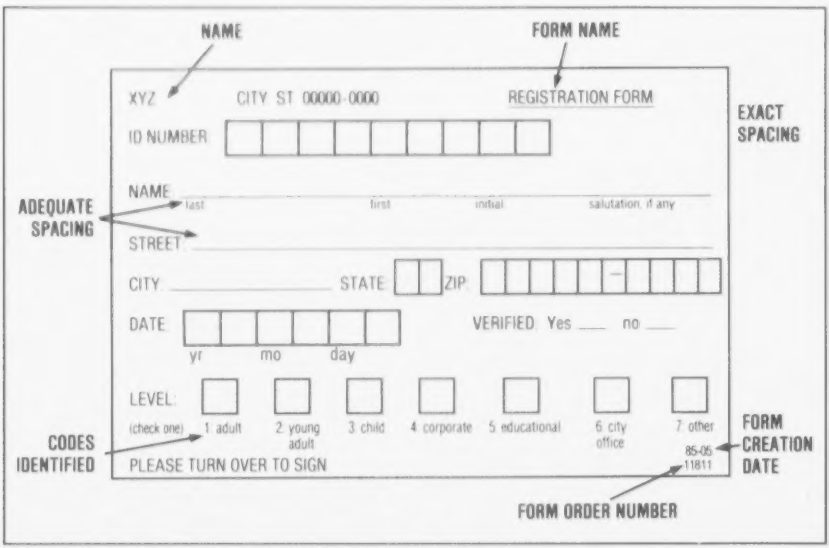
Figure 8.1 shows an example of good form design for a student registration application. For now, we will assume that the present Student Enrollment Form is adequate for our data gathering needs, and will not be redesigned. In addition the order card for our Library/Media Center application is a standard, commercially-available form and will also not be not redesigned.

2. Input Screen Design

A major component of any computer application is data input. A good screen design is essential for accurate and rapid data input. Among the points you should consider when designing your input screen are the following:

- Incorporate all the points discussed above regarding form design
- Parallel the design of the printed form to facilitate quick data input

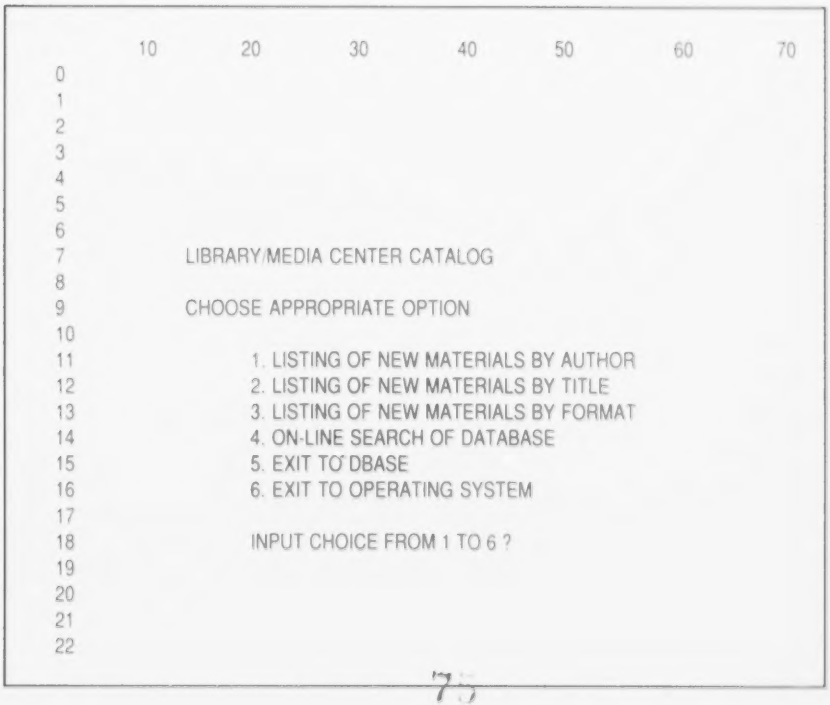
Figure 8.1
Good Form Example



- Use color and highlights, e.g. inverse video, to identify data elements
- Identify the end of data elements with an audible sound such as a beep or a bell
- If possible, keep input to one screen display
- Leave the top and bottom lines of the screen available for messages, and consider the use of different colors or reverse video to display those messages
- Provide menus, in list or pull-down format for assistance in accessing other capabilities of the software, and for the most common menu items, allow the user to access those options through direct keystrokes if they desire
- Provide easy access to context sensitive, on-line help assistance
- Provide easy access back to the main menu at any time, and develop an escape option that allows the user to "back-out" of a series of steps if a mistake is identified

It is useful to review the layout of a typical screen display. Using this display structure, one can easily decide where to place data collection fields. For example, a menu display of options should appear near the middle of the screen as shown in Figure 8.2.

Figure 8.2
Typical Menu Screen



3. Output Design

An output can be a printed report or a screen display. In the development of outputs, the same issues discussed for input are appropriate. In addition, you should consider the following points:

- Prepare standard output text with a computer printer but consider the cost-effectiveness of other approaches, such as the use of commercial preprinted forms
- Consider the number of copies which need to be prepared and the method of reproduction
- Consider using binders to hold computer generated reports
- Use adequate margins if output is to be placed in notebook-style binders
- Consider photocopying printouts on two sides to reduce volume of product
- Use indentations and blank spacing to facilitate reading and scanning of the output
- Number the pages in the report
- Use page headers to identify the report and the date it was generated

All these points should be considered in the design (or acceptance) of the required products for your computer application.

4. User Cordial Interfaces

Naturally, if we want to have a user based system it must be user cordial or friendly. Many of the elements previously listed under input and output design should be incorporated into a user-friendly system. However, in developing (or accepting) processing interactions which are friendly you should also consider the following:

- The use of menus rather than reliance on commands issued directly from the keyboard
- Provide an adequate number of options in each menu
- Allow for simple and direct escape from the system
- Make it easy to get back to the beginning of the application and to the operating system. Consider including an option that allows access to the operating system without having to exit from the software program
- Provide on-screen instructions and include on-line help functions
- Allow the user to by-pass sequences of menu displays and go directly to specific functions either by issuing a command, or allowing menu choices to be made by typing the menu item number or the first letter of each menu choice
- Allow interaction options for new and experienced users
- Don't overload the user with too much information on the screen display

Further discussion on involvement of users in the design, implementation and operation of an automated computer system is contained in Chapter 10.

5. Processing

The processing step is an important component of our design phase. As with the discussion of input screens and outputs, many of the processing steps associated with a commercially available system are a given. However, the administrator frequently needs to design the manual processing steps which go along with any new system. Techniques described earlier, specifically flowcharting, can help in designing such new manual processing routines.

Similarly, an in-house design also requires the development of manual processing routines. But in addition, a system developed in-house requires the creation of computer processing routines. These can include such elements as:

- Decisions on how to link database files
- Procedures and timing of database input and editing
- Report production scheduling
- Procedures and timing of indexing and sorting
- Procedures and timing for database changes
- Procedures and timing for database backup
- Error correction routines
- Maintenance procedures for the software, hardware and data

Specific Design Application 1— Student Records and Scheduling

As stated previously, the design of a commercially available system is a given. In fact, one of the advantages of choosing a commercial system is the fact that the design already exists. The hypothetical system we selected for the student record keeping and scheduling application, System Z, is an integrated system consisting of a number of modules: the student database, scheduling, attendance, grading, testing, academic history, discipline, and school bus modules.

The software operates on a minicomputer which is housed at district headquarters. Access to the system is available through terminals located at each of the school sites and at district headquarters. Printers are available at each site; a fast, high quality printer is located at headquarters while slower, less expensive printers are found at school sites.

Data can be added to the modules at each site, and each module can be searched interactively. The user accesses the system through an extensive, but easy to use, series of menus. Reports can be produced locally at school sites, or larger reports can be generated at district headquarters.

The following represents examples of reports and interactive queries from one of the modules, the student database module.

Reports Produced:

- Master student list by ID
- Master student list by name
- Master student list by address

Figure 8.3
Typical Screen Display

SYSTEM Z
Student Database Module

Select District Level of School Number: ____

Menu Option - Level 1

Display or Print Options:

01 Master Student List by ID — Abbreviated
02 Master Student List by ID — Complete
03 Master Student List by Name —Abbreviated
04 Master Student List by Name — Complete
05 Student Master Profiles

09 Next Student Database Menu Option List

Menu Option: ____

Figure 8.4
Typical Report Output

Date: 11/01/92 Page: 001

Master Student List by ID Number —Abbreviated Information

ID Number	Name	Sex	School	Grade
000101110	Palmer, Roger C.	M	01	05
000123000	Wilson, Mary	F	05	09
000124099	Iehl, Ronald E.	M	06	12
000125000	Hamilton, Eloise	F	03	02
000128922	Costello, Steven	M	01	05
000199099	Rohal, Nancy	F	06	11
000200010	Keyser, Lynn W.	F	01	02
000210000	Holoch, Alan	M	05	08
000220002	Fairbanks, Richard	M	05	09

- Student master profiles
- Statistical summaries by sex, language, ethnicity, special programs
- School rosters
- Homeroom/teacher rosters
- Mailing labels
- Split family address labels
- Student directories

On-line Interactions:

- Database maintenance, updates, deletes, changes
- Student record inquiry
- School, teacher, homeroom inquiry
- Address, street inquiry
- Statistical summaries

A typical screen display from the Student Database Module is shown in Figure 8.3, and an example of a portion of a typical student list report is shown in Figure 8.4.

Specific Design
Application 2—Library/Media Center

In the selection phase of our study, the input requirements and data dictionary were outlined for the Library/Media Center application. In addition, an analysis of the marketplace and review of our specific requirements led us to a decision to select a system that operated on an IBM PC or compatible computer. In this phase we will outline the design for the various inputs/outputs and specify the microcomputer processing routines using the DBMs software dBASE III+.

Every database management system has its own unique method for defining record structures, inputting data, searching, and generating reports. Thus, it is important to have an understanding of the unique methods associated with dBASE III+ prior to designing this system.

The purpose of the following example is not to provide instruction in dBASE, but rather to illustrate the typical types of decisions required for implementing this Library/Media Center design. We assume that the design outlined below would be prepared by an individual already knowledgeable in dBASE.

Specifically, the dBASE III+ design would consist of the following elements: creating the database structures for both the teacher/administrator and the material files; inputting and editing data for these databases; using an interactive report generator for the production of our mailing labels; and using dBASE programming capabilities to generate our bibliography of new Library/Media Center titles.

dBASE requires that you provide the record structure in a standard that it has been programmed to recognize. This process is activated through the use of the Create command. Using this command, the following dBASE III record structures are created for the teacher/administrator file (Figure 8.5) and for the material file (Figure 8.6). It should be noted, however, that in

Figure 8.5
dBASE III+ Record Structure Teacher/Administrator File

Field Name	Type	Width
NAMEID	Character	10
NAMELAST	Character	20
NAMEFRST	Character	15
NAMEI	Character	1
SALUT	Character	4
LEVEL	Character	1
STREET	Character	32
CITY	Character	20
STATE	Character	2
ZIP	Character	5
ZIP4	Character	4
SCHOOL	Character	15
S_STREET	Character	32
S_CITY	Character	20
S_STATE	Character	2
S_ZIP	Character	5
S_ZIPADD	Character	4
ROOM	Character	4
TELEPHON	Character	12
TOTAL		**540**

Figure 8.6
dBASE III+ Record Structure Material File

Field Name	Type	Width
MATERLID	Character	5
TITLE1	Character	60
TITLE2	Character	60
AUTHORS1	Character	60
AUTHORS2	Character	60
PLACE	Character	30
PUBLISHER	Character	30
DATE	Character	4
DESCRIP	Character	30
CALLNUM	Character	14
FORMAT	Character	1
SUBJECT1	Character	45
SUBJECT2	Character	45
SUBJECT3	Character	30
NOTES	Character	6
AVAILABLE	Character	6
TOTAL		**540**

our situation a teacher/administrator file already exists. At present the file is maintained in dBASE III+ by the administrative office. The Library/Media Center can negotiate to use this file for file creation rather than inputting all the data again.

Once the record structures have been developed, the Append command can be used to add data for each of these dBASE III+ files. Using the Edit command, data in each record can be displayed, and edited if necessary. Sample data for the teacher/administrator and the material files are contained in Figures 8.7 and 8.8 respectively.

In addition to creating the record structure, and inputting and editing data, dBASE programs need to be written to generate the products specified in our output analysis and design phase, specifically, the bibliography and the mailing labels. dBASE III+ contains an interactive report and label generator that allows you to specify what is to be printed from a database file.

The label generator will be used to create our mailing labels. However, the report generator is inadequate for printing our bibliography. Instead a dBASE program needs to be written to create this product.

Examples of the interactive dBASE label generator and the program for printing the bibliography are shown in Figures 8.9 and 8.10. Again, it should

Figure 8.7
Sample dBASE III+ Data Entry Teacher/Administrator File

Field	Data
RECORD NO	1
NAMEID	1101181719
NAMELAST	Plate
NAMEFRST	Kenneth
NAMEI	H
SALUT	Dr.
LEVEL	1
STREET	11684 Ventura Blvd.
CITY	Studio City
STATE	CA
ZIP	91604
ZIP4	
SCHOOL	John Muir
S_STREET	12345 Wilcox St.
S_CITY	Altadena
S_STATE	CA
S_ZIP	99900
S_ZIP4	
ROOM	314
TELEPHON	818/797/7654
INDATE	120988

Figure 8.8
Sample dBASE III+ Data Entry Materials File

Field	Data
RECORDNO	1
MATERLID	50001
TITLE1	Understanding Library Microcomputer Systems
TITLE2	
AUTHORS1	Palmer, Roger C.
AUTHORS2	
PLACE	Studio City, CA
PUBLSHER	Pacific Information Inc.
DATE	1988
DESCRIP	128p
CALLNUM	Z678.93.M53P35
FORMAT	1
SUBJECT1	Libraries—Automation
SUBJECT2	Acquisitions (Libraries Automation)
SUBJECT3	
NOTES	Professional Skills Series
AVALABLE	090188

Figure 8.9
Using dBASE III+ to Generate Labels Sample Program and Label

Interactive Label Generator

Structure of file:	NAME.DBF	
Label Contents	1	SALUT, NAMEFRST, NAMEI, NAMELAST
	2	SCHOOL, ROOM
	3	S_STREET
	4	S_CITY, S_STATE, S_ZIP, S_ZIPADD
	5	
Width of label:	35	
Height of label:	5	
Left margin:	0	
Lines between labels:	1	
Spaces between:	0	
Number of labels across:	1	

Sample Label:

Dr. Kenneth H. Plate
John Muir 314
12345 Wilcox St.
Altadena CA 99900

be noted that some dBASE expertise is required prior to activating the label generator and programming option. The dBASE documentation is helpful in this regard, as are the large number of publications on the subject of dBASE.

The bibliography generated from dBASE would be used as camera-ready copy and would be attached to the Library/Media Center Information Bulletin generated from a word processing package. An appropriate number of copies would be prepared for distribution. Copies would be distributed in the library.

Labels would be generated for attachment to folded copies of the Library/Media Center Information Bulletin for mail distribution to teachers, staff, and administrators.

Figure 8.10
Using dBASE III+ to Generate Reports Sample Program and Report Output

dBASE III Program for Generating Bibliography

```
SET HEADING OFF
SET SAFETY OFF
SET TALK OFF
USE MATERIAL INDEX CALLNUM
GOTO TOP
SET PRINT ON
DO WHILE .NOT. EOF()
?
? CALLNUM
?  '      ', AUTHORS1
IF SUBSTR(AUTHORS2,1,3) <>'
? AUTHORS2
ENDIF
?  '      ', TITLE1
IF SUBSTR(TITLE2,1,3) <>' '
? TITLE2
ENDIF
?  '      ', PLACE, PUBLISHER, DATE
?
SKIP
ENDDO
SET PRINT OFF
```

Sample Citation from dBASE Program for Bibliography

```
Z678.93.M53.P35
PALMER, ROGER C.
Understanding Library Microcomputer Systems.
Studio City CA Pacific Information Inc. 1988
```

Summary

Systems design includes the design of a new input form as well as the design of input screen formats. As with the analysis phase, design involves detailed output descriptions. In this case we are concerned with describing the products of the computer application, which involves outlining the characteristics of screen displays and computer-generated printed products. It is important to develop user-friendly interfaces. Additionally, the tasks which are to be performed in our new application are outlined. A number of systems techniques can be used to assist in this processing phase—flowcharting being one of the most useful. As appropriate, the issues associated with systems design may be used to fine tune the requirements or selection criteria for commercially available packages.

CHAPTER 9
Implementation & Management

System Housekeeping Tasks

In the analysis and design of a computer application there are a number of other issues to be considered. First, you should develop general computer "housekeeping" procedures. These procedures include such obvious, yet important, functions as preparation of software and establishing a system for file backup. Usually, the first instruction provided with a software package, whether an operating system or an application package, is how to make a backup copy of the software. If the software is damaged or misplaced, a backup will enable you to salvage your application.

Similarly, any files you create should be backed up on a regular basis. For example when using a microcomputer application, it is a good idea to save your working files every 15 to 30 minutes. If there is a power loss or if you remove the data disk incorrectly, your data loss will be minimized. It should be noted, however, that backup files consume substantial amounts of disk space.

You should review your backup files on a regular basis and delete files that are no longer needed. It is also good practice to store a copy of the software and important data files in another location. Thus, in the worst case situation (such as a fire in your office), all of your software and data files will not be destroyed. It is also important to store magnetic media, such as diskettes and tapes, where they will not be damaged by dust or dampness.

Documentation

Once the computer system has been analyzed and designed it is essential to develop documentation about the application. This documentation includes: system/processing; programming; and user-based documentation. Remember that documentation serves a variety of purposes and is used by a variety of different groups, therefore, prepare documentation with these varying purposes and users in mind.

A commercially available system may have all of these categories of documentation included as part of the procurement, or occasionally addi-

tional user-based documentation may need to be developed in-house. Points to consider in developing these different levels of documentation include:

- Knowledge about the level of user familiarity with the software/hardware
- Use a clear, precise writing style with a minimum of jargon
- Incorporation of a good table of contents and/or indexes into the documentation
- Providing well-structured and organized documentation
- Use of different type fonts, outlining, and blank spaces to highlight special or important points
- Liberal use of illustrations and sample problems
- Making certain that the documentation is current and that adequate procedures for updating it exist

The following topics should be included in the documentation:

Overview

- Introduction and background
- Requirements of application
- Hardware and software requirements
- Overview of application (narrative)
- Overview of application (flowchart)

Data Preparation

- Form examples with sample data
- How to complete forms
- How to prepare for data input

Data Input

- Computer operating procedures
- Sample record
- Input procedures
- Screen displays
- Problem solutions

Processing and Products

- Computer operating procedures
- Sample screen displays
- Sample products
- Procedures for producing products
- Problem solutions

Housekeeping Routines

- Creating backups and file deletions
- Maintaining documentation

Data and Programs

- Sample record structures
- Program listings

Index

Implementation

Once you have designed a computer system, you must implement it, and build into that system certain mechanisms to monitor it and provide feedback. System implementation involves:

- Decisions as to selection of implementation procedures
- Consideration of the various implementation tasks

A system can be implemented in a variety of ways: all at one time, in parallel, or through a modular approach. Most small microcomputer systems are implemented all at once. More complex applications, such as one involving all of the components of a student record system, could be implemented in parallel. Parallel implementation requires maintaining the old system (and gradually phasing it out) while the new one is implemented. There are advantages to this approach, including the safeguard that if something goes wrong there is a back-up available; also it allows you to gather data on the effectiveness of both systems.

As discussed above, more complex systems consist of subsystems which interact. In a step-by-step implementation (modular) one implements small units and makes sure that the first unit works before progressing to the next. This approach has advantages including the fact that it is easier to implement smaller parts than a whole system at once; and staff can become accustomed to the new system more gradually. One of the problems associated with a modular design is that concerns about individual components may prevent the completion of the whole system.

Implementation Tasks

There are numerous tasks associated with the implementation of a computer system. Of course, the specific tasks vary by type of application. However, the following are among the most common tasks you will need to complete to successfully install and operate a new computer application.

Management Planning

At the initial stage of our analysis we discussed the utilization of various techniques to assist in project management. These same techniques, specifically Gantt, PERT, and CPM, could be used to organize and plan an implementation phase.

Procurement

Purchasing the selected hardware and software is not always a straightforward matter. A formal procurement process similar to those discussed in Chapter 7 may be required.

In addition, a number of factors could cause a delay in procuring the desired system. These factors could include: the need for administrative and school board approval, the district's purchasing department requirements may take a few days to complete, complex negotiations or the need to generate a complex contract with the vendor, or the temporary unavailability of hardware or software.

Conversion

In many applications it is necessary to convert existing manual files into machine readable form. For some applications, particularly those involving the creation of large databases, such as for student records, personnel, and library/media catalog records, the file conversion task may be considerable. For any file conversion you should determine how the files will be converted, and who will perform that conversion. In some instances, it may be possible to interface with an existing database and download records into your own file.

However, for most computer applications it is far more common to convert files through manual keyboarding. If adequate staff are not available in the school to perform this conversion, temporary personnel can be hired, or the data can be sent to a service bureau. For complex data it may be useful to investigate the use of trained data input personnel who work for consulting or temporary employment firms.

Site Preparation

The larger the on-site computer system, the more complex the site preparation. Both minicomputers and mainframes require strict environmental controls for correct operation. These include the design of a facility for the hardware which has the following features:

- An uninterruptable power supply
- Power panels and receptacles
- Air conditioning, dust and humidity control; and adequate water supply for cooling
- Static electricity control
- Raised flooring (and/or false ceilings) for cabling
- Adequate floor support
- A telecommunications system
- Adequate space for hardware, storage, workspace, and personnel
- Paper waste disposal capabilities
- Fire protection

Lighting and power considerations are often forgotten in the crush of other, more immediate concerns. Lighting has an impact on both space and environment. To illustrate the dimensions of the problem, consider that the suggested illumination for accounting tasks (working with spreadsheets) is 150 footcandles, whereas viewing a video display unit requires only 30 footcandles. Glare can be reduced by using low-luminous fluorescent lighting, drapes or shades on windows, screen hoods on terminal screens, and matte finishes on table tops. Individual, adjustable lights may be needed (Cohen & Cohen, 1983, p. 200-205).

The provision of adequate electrical power and telecommunications outlets is often a problem, particularly in older facilities. The cost of rewiring can be extraordinarily expensive. Modern methods such as flat wire, under-carpet grids, and power poles to overhead plenum cabling hidden behind false ceilings offer less costly alternatives to traditional in-wall and under-floor systems.

Computers and data storage mediums such as floppy disks are subject to damage from a variety of electrical sources:

- *Surges and Spikes (of short duration)* — Caused by utilities switching lines, nearby power lines being hit by lightning, and intermittent operation of motors such as in elevators and air conditioners.
- *Noise* — High frequency electrical impulses caused by auto ignition systems, transformers, fluorescent lights, static electricity and storms .
- *Voltage Fluctuations* — Caused by loss in power transmission, uneven regulation of voltage, and brownouts (intentional lowering of voltage by utilities during peak operating periods).

Equipment and data can be protected against surges and spikes by using power line protectors that also double as multi-outlet junction boxes. In-line monitoring devices are available which warn of serious voltage fluctuations that can destroy equipment and/or data. Static electricity is often a problem in carpeted areas and during periods of low humidity. Care should be taken to select carpeting that is static-resistant such as olefin, nylon or acrylic.

Since microcomputers operate in the normal office or home environment, there is usually no need for a complex site redesign. However, it is necessary to provide new desk and work space for the microcomputer application.

Likewise, it is important to investigate, if needed, provisions for adequate electrical outlets, static electricity safeguards, and disk storage devices. Many traditional general office and school suppliers offer microcomputer furniture and accessories. In addition, there are a large number of vendors who cater specifically to this marketplace.

Some of the vendors who provide microcomputer furniture and supplies include:

- The Drawing Board, Computer Supplies Division Office, 256 Regal Row, P.O. Box 220505, Dallas, TX 75222; (800) 243-3207
- Educational Resources, 2360 Hassell Road, Hoffman Estates, IL 60195; (800) 624-2926
- Gaylord Bros. Inc., Box 4901, Syracuse, NY 13221; (800) 448-6160
- Global Computer Supplies, 2318 East Del Amo Boulevard, Department 83, Compton, CA 90220; (800) 845-6225
- J.L. Hammett Company, Box 545, Hammett Place, Braintree, MA 02184; (800) 972-5056; (800) 225-5467 (outside MA)
- Highsmith Co. Inc. P.O. Box 800, Highway 106 East Fort Atkinson, WI 53538; (414) 563-9571

Supporting the Microcomputer Facility

A look at one of the many mail-order computer supply house catalogs or a walk through a modern retail business supply store illustrate the variety of supplies, furnishings and devices available for microcomputers. Just what your facility will require will depend upon a number of factors:

- Type and variety of equipment available

- Level of service provided
- Budgetary limitations

Even a bare bones facility will need to consider the following items:

- Dust covers to protect CPUs, monitors and keyboards when not in use
- Disk drive head cleaning kit
- Floppy disk envelopes and binders or storage units
- Surge protectors (see above)
- Blank diskettes for making backup and distribution copies of programs

If line printers are provided it is important to consider not only the kind of printer—dot matrix, daisy wheel, thermal, or laser—but also the costs of supplies, namely paper, ribbons and toner.

Training

Training is the third component of any computer application (the other two being hardware and software). Without adequate training, the most elegantly designed computer application can, and probably will, fail. Thus, it is essential to develop appropriate training for staff who will use the system. Possible training methods include:

- Courses and workshops
- Books and print materials
- Documentation
- Media, such as videocassettes
- Computer-based training, e.g. diskette-based

There are advantages and disadvantages to each of these training methods. However, the use of courses/workshops or computer-based training, followed-up with the use of printed materials are the most successful. A review of the pro's and con's of the various training options can be found in an article in *Microcomputers for Information Management* (1985).

Public Relations

A public relations effort for a new system can be achieved through a variety of means, such as through new system publicity, adequate orientation or training procedures, and the design of easy-to-use, user-cordial systems. For example, our initial needs assessment indicated that administrators, staff, and teachers were dissatisfied with the student record/scheduling system. The new computer-based application resolves the problems associated with the old system — a publicity effort could be implemented to alert administrators, staff, and teachers about the implementation of a new, improved service.

Systems Monitor

When we design and implement a system we must monitor that system to see that it is achieving its objectives, within the constraints. Data are typically produced from the system and provided to management, who then can ascertain whether or not the system is operating correctly.

In a school setting, systems monitoring and feedback refers to the generation of adequate reports, such as numerical compilations, including:

tabulations of the number of items ordered; number of updates to various databases; vendor performance analysis; rate of production; and processing speeds. Additionally, the gathering of attitudinal responses from users also provides feedback on system performance.

For our specific applications, feedback on the performance of the system could be provided through:

Student Records System:

- Number of inquiries to student records
- Response time of computer to inquiries
- Unit costs of various report productions
- A comparison between the target dates for report generation and the actual dates of generation
- The use of an attitudinal questionnaire on the worth, quality, personal reactions to new system

Library/Media Center Application:

- Volume of Library/Media Information Bulletins distributed
- Number of requests for Library/Media Bulletins
- Volume distributed by mail
- Number of mail requests
- A follow-up of the original user needs assessment to solicit information on the new system
- The use of an attitudinal questionnaire on the worth, quality, personal reactions to Library/Media Center Information Bulletin

Evaluation

In some instances it may be sufficient to provide feedback data on the operation of a new system through responses to attitudinal questions. In other instances, however, it may be more appropriate to describe the new system in terms of cost-effectiveness. Whereas feedback provides data in isolation to other systems, cost-effectiveness implies the comparison of the present system to alternatives, including the previous system.

It should be noted that in many systems studies, cost-effectiveness evaluation occurs prior to the design of a new system. One gathers cost and effectiveness measurements on the present system and compares these to the cost-effectiveness measurements of all possible alternatives — those systems which solve the problem and meet the objectives, within the constraints. This type of comparison is known as a trade-off study. Our utilization of systems analysis made the assumption that a computer-based application was the most cost-effective.

In a typical cost-effectiveness evaluation, data are gathered on the cost of the system, as well as on various performance measures. Performance measures to be used in the evaluation would vary by the type of system, but might include:

- User responses to a knowledge of products and services before and after the inauguration of the new computerized system

- Overall user responses to products and services before and after the inauguration of a new computerized system
- User evaluation of the system before and after the inauguration
- Time to answer requests for information before and after the new system
- Time to produce reports calculated before and after the new system
- Cost to produce products and services before and after the inauguration of the new system
- Overall cost and unit cost to produce the products and services versus the cost not to produce it, e.g., $0

A cost-effectiveness evaluation would tabulate the data for the previous system and compare it to the new design. This data could be displayed in a chart such as that shown in Figure 9.1.

Summary

In addition to the variety of tasks associated with the preliminary analysis, input and output analysis and design, processing concerns, and hardware and software selection, there are certain tasks important to the implementation and monitoring of a new system. Upon completion of the implementation, the analyst should develop procedures whereby the system will be monitored and periodic feedback provided to management on the performance of the new system. In addition, a more formalized process, namely a cost-effectiveness evaluation study, can be conducted to provide additional evaluative data.

Figure 9.1
Representative Cost-Effective Evaluation Chart Student Record Reports

Factor	A	B	C	D	E	F	G
System 1 (Old)	$95	3.0 hrs.	6	115	5.00 min	3	1
System 2 (New)	$110	0.5 hrs.	21	197	0.30 min	4	5

A = Unit cost to produce one type of student record report (typical example)
B = Time to produce a typical listing (typing, data input, listing generation)
C = Number of reports/displays available
D = Number of requests for information on student record information (weekly basis)
E = Average time to respond to student record requests
F = User knowledge of products (scale 1-5 high to low)
G = Overall user evaluation of products (scale 1-5 high to low)

CHAPTER 10
Administrative Issues & Strategies

Up to this point, our discussion has focused on analyzing your needs and determining what software and hardware you should consider for automation of specific functions. There is one additional, and critical, factor you must consider before beginning a computer implementation program — the human element. Computers do not solve problems, they are merely a tool that helps you solve a problem, simplify a complex task, or improve your ability to complete repetitive tasks in an efficient manner. Automation of any task will only be successful to the extent that the people responsible for the task accept and use the computer. This chapter considers these human issues in more detail, offering suggestions on the roles of various staff members in the business office and throughout the school district, and offering strategies to ensure successful implementation of a computing system in your district. We begin with a discussion of the human issues that need to be considered as you proceed.

Human Issues

The use of computers has had a profound effect on schools. New services have been inaugurated and new internal processing interactions and procedures have been developed. In all these instances there is considerable human-technology interaction. Individuals must interact with specific hardware and software; and the physical site must accommodate the requirements of computers.

However, too frequently the unique characteristics and requirements associated with computers and their associated human interactions have not been addressed. The effective use of computers in schools, and indeed the need to increase productivity, requires the correct interface of both. Thus, in any consideration of this topic there are two major foci: the needs of the individual; and the needs of the technology, in this case the computer.

There are a number of components associated with the study of the interplay of individuals with the work environment (ergonomics). These components include: the physiological, the psychological, and psychosocial. Physiological aspects of individual needs include the study of the relation of

body dimensions and the dynamics of the body to work performance (biomechanics and anthroprometrics); and the interaction of human senses with technologies, particularly the interaction of vision and the visual system with video display terminals (VDTs). The psychological aspects refer to the attitude of the individual to the computer and to the cognitive-level interfaces with the machine. Psychosocial refers to the effect of technology on the individual worker in a work group and the effect on the organization.

Physiological Aspects

The human body is indeed a complex entity, and there is considerable variation of body characteristics, such as in height and weight. The interactions of a human with a computer, particularly in working at a VDT, require that the opportunity to adjust for individual differences be available. Failure to allow for adjustments can create problems, particularly postural and visual strain. Early computers rarely provided for individual differences. Today a great deal of effort has been expended in the design of technologies to improve human interface with computers. Ergonomically designed chairs, desks, tables, keyboards, and individual work stations allow for individual variation in physical characteristics and personal traits.

A review of catalogs selling school, audio-visual, computing, and even general office furniture shows how important ergonomics has become in computer design. Chairs are designed to fit the human shape and its movement. Systems furniture provides a variety of work surfaces, storage, electrical and lighting options.

Specific features particularly relevant to computerization include step-down counters for keyboards, noise control devices for noisy printers, integration of power and network cables into furniture, and surfaces for note-taking and writing. Landscape system partitions and screens provide privacy as well as the ability to design of a variety of work, meeting, and storage areas.

There has been considerable attention directed towards the design of the VDT itself. Today, screen resolution and contrast are adjustable; the screen and keyboard are moveable allowing for different human features and personal work patterns. Considerable research has been directed toward video displays and vision. This research has identified a number of parameters important to VDT design and interactions (National Research Council, 1983; Scalet, 1988):

- Use of acceptable colors
- High resolution image quality including luminance, positive contrast displays, and elimination of observable flicker
- Variation in character size and fonts
- High quality character formation
- Appropriate information density
- Good lighting environment
- Elimination of reflection, including glare reduction

Many of these components cannot be individually controlled, nor is the individual even cognizant of many of them. Consequently, it is essential that managers design work sites that eliminate or reduce the possibility of vision and other ergonomic problems.

The interest in VDTs has been heightened by the attention given to the effects of these interactions, specifically the effects of radial emissions, on the human body. This subject in itself has created a certain amount of stress for the worker. A recent article highlighted the possible problems associated with extremely low frequency (ELF) electromagnetic emission, most importantly the possible cancer risk (Brodeur, 1990). Work is progressing in this area to reduce or eliminate such risks—standards for monitors are being developed and integrated into their manufacturing.

The keyboard remains the basic input device for computer interactions. A great deal of effort has gone into making this aspect of human-machine interaction more comfortable. For example, even though considerable effort was spent on the design of the IBM-PCs first keyboard, there were many criticisms of its layout. Competitors developed keyboards which incorporated more comfortable designs and had a tremendous impact on the market.

Other human needs, in addition to visual and keyboarding comfort, are also of importance in technological work design. This includes the development of a suitable interior work climate with control of temperature, air quality, and noise. Again, individual difference do have an effect. For example, different age and sex groups typically have different temperature requirements. In addition, clothing style can also have an effect on the comfort of the environment.

Psychological Aspects

Aside from individual physiological needs, there are psychological needs. These include consideration of such elements as the need for privacy of interpersonal space and speech. Privacy provides for individual thinking and working, the feeling of independence, and the ability to control access of others into one's own space. Individuals desire knowledge privacy, or the ability to control from others the information being displayed on a VDT.

This privacy can be accomplished in a number of manners, such as the self-regulation of personal space by individuals themselves; the use of the body to deflect viewing of the screen—commonly used in standing interactions; and by the use of work-stations, or carrels, which blocks entrance of other individuals. In a work setting, the use of partitions and screens has been a particularly effective device in guaranteeing personal privacy.

Attention has been given to the problems associated with human-computer interaction. These include problems on the affective and cognitive levels. Typical of the problems exhibited by workers on the affective level include: high levels of anxiety; the lack on interest and willingness to learn new tasks, such as not wanting to be retrained for an automated system or an upgrade to a system; development of poor work habits; changes in

personality; a feeling of loss of control because of automation; the belief that the computer is a threatening device; alienation and isolation; and on the opposite end of the spectrum, the belief that the computer is the solution to all the information and processing problems in the school.

On the cognitive level, workers have raised the following types of concerns: the information/computer overload problem, that is, there is too much to learn and remember; the complexity of dealing with large numbers of computer systems, searching methodologies, and telecommunications networks; inconsistencies with technology terminology; difficulties with documentation; the lack of flexibility in operating the technology; the overall complexity of a technology which was not designed for non-specialists; a lack of desire to learn to use a new technology until there is a need, and then it is too late to learn because of the system complexity; poor results from interactions; and the generation of too much information.

Methods have been investigated to discover the "why" for failures in human-machine interactions, the "how" to design better systems, the "way" to reduce the effort for the input operator, user of work-enhancement software, and the "means" of producing increased and improved results in technology interactions. Strategies have included: the use of orientation and training programs to overcome computer-phobia; the use of front-end processors and artificial intelligence (AI) systems to assist in computer interactions; and the use of individual differences in choosing the type of interactive sessions.

Specifically, new designs have taken into consideration the following: attempts to minimize the amount of knowledge the user has to bring to the system through the use of menus, easy to remember commands, help functions, iconic or graphic displays, and interactive questioning; developments in training, such as on-line tutorials, and supporting training materials in a variety of media, including print, simulation, computer-based training (CBT), and interactive videodisk; and incorporating positive learning components into the interaction with the technology, such as attention-getting mechanisms, motivators, advanced organizers, prompts and cues, and feedback.

Although much has been directed towards the psychological problems associated with human-machine interactions, there are many positive forces at work. Some individuals find that involvement in automation is motivational. These individuals find excitement, challenges and rewards in doing something new. Automation can provide opportunities for job variety and job enrichment, and in higher-order problem solving. Such opportunities are motivational in themselves and create a higher level of satisfaction in the worker. Additionally, automation can provide the opportunity for upward mobility for workers who might otherwise feel constricted by their present position. Opportunities for future advancement can create a "better" performing employee.

Psychosocial Aspects

Technology not only has an impact on the individual worker but also on individuals as members of a work group, such as in administrative services, and as members of the larger organization, the entire school. Frequently, the development of a new automated system requires job redesigns and changes in the work flow. The impact of such changes affects all levels of individuals in an organization but is particularly acute at the non-managerial levels. There is a resistance to change in some individuals—not only is there a disruption in daily work patterns but there can also be a perception of alienation since workers find that they cannot control their work or social work group interactions. Training can be an excellent method to overcome such problems, but unfortunately it frequently lags behind system implementation.

But there are positive psychosocial aspects of the use of technology in schools. For example, automation allows a manager the flexibility to change job tasks and social work groups thereby providing an opportunity to resolve existing productivity or personnel problems. Automation can also provide the potential for facility redesign which could increase productivity. The effective use of automation by an unit an also present a positive view to top management that the unit is a dynamic, forward-looking entity.

Human Issues—Managerial Issues

The use of technologies have had many physiological, psychological, and psychosocial effects on the individual and the organization. There have been problems but for the most part these are being addressed. And it should be noted that some of these problems are minimized in small schools where the technology, such as a video display terminal, may not used by one employee for an eight-hour period. But regardless of size, many individuals and organizations have made a smooth transition from existing systems to new, computer-based ones.

Such individuals and organizations have a common characteristic—they accept change. The literature of "the diffusion of innovation" identifies the characteristics of individuals and organizations which accept change, such as managers with high professional rating and short tenure, and organizations where there is a new leader and friendship exists among interacting units. In addition, innovations (technologies) which are apt to be accepted tend to have high visibility, have definable advantages over the old system, are compatible with the old system, and relate to a preconceived need. Such characteristics of a technology are essential for user acceptance in psychological terms and to management in cost-effectiveness terms.

The manager has a number of strategies at his or her disposal which can assist in technological change. The manager can use one of the elements of systems analysis which indicates that involvement of staff in the design and implementation of a new system generates a vested interest in the system, the result of which will be a more positive approach by the worker.

Managers should understand the capabilities and the individual differ-

ences of their staff (through personal knowledge of their workers or through the testing of individuals when large numbers of employees are involved) to ascertain which staff members are more amenable to accepting change. These individuals can be identified as change agents and act as models for other workers.

Good training is another common characteristics of individuals and schools which have made a smooth transition to implementing a technology. Training programs which are specific to a new technology are essential. But there should also be programs which concentrate on affective-level training for those individuals who are not "positive" in their reactions to change and to the use of new technologies. Overall, a positive attitude can be developed in employees—an attitude which correctly portrays the capabilities and limitations of technologies and their role in schools (Kazlauskas, 1988).

Technology Issues

As outlined in Chapter 9 of this book, there are numerous physical site design requirements associated with any type of computer system. Specific topics to be addressed in a computer site design include: power source and control; environment control through regulation of air, temperature, humidity, dust, and static electricity; appropriate flooring for cabling and support; water for cooling needs; telecommunications connections; waste control for large paper volumes; fire hazard reduction; and physical access control.

To assist the school administrator, vendors of automated systems typically provide detailed requirements prior to installation. These specifications cover such topics as: space (system dimensions, system space requirements, storage space for disk packs, paper supplies, shipping cartons, documentation supplies, future expansion, and minimum room size); electrical (power lines, line conditioner, line labels, terminal power); telephone; environment (air conditioning, static conditions control); and area for receiving delivery of the system (Cortez and Kazlauskas, 1986, p. 71).

An effective site design considers the interplay of the physiological, psychological, and the psychosocial needs of the individual, with the technology—the computer. Such a design should take into consideration:

- An effective work design includes the interplay of task, environment, and workplace
- Concern should be placed on the micro environment, that is, the design of individual space; but also to the mini environment, such as the work desk; and the macro environment, such as the building ceiling and flooring system
- A design should allow for individual differences in VDT viewing distances and inclination, keyboard location, leg space, seating characteristics, foot support, writing and work surface requirements
- The design should be based on the characteristics of the user group, e.g. school children have different physiological and psychological needs than working adults

- Provision for personal work space
- It is useful to request feedback from employees to assist in developing staff satisfaction with technologies
- A manager should incorporate adequate break/rest periods for staff who work with VDTs
- Systems analysis techniques, such as project management, should be used in developing computer-based systems and this process should included attention to the "people" issue
- Consider that there might be a change in the internal work processing flow due to use of a computerized systems
- The work flow patterns used in a manual system may no longer be effective

Computing Issues

There are a number of issues which currently face the administrator of a computer system. These issues are the same whether the installation is a single PC-based system or a large mainframe. These issues include privacy and computer crime.

Privacy is the ability to control who uses personal information and to control the manner in which it is used. The creation and availability of databases of information about students and staff can make such personal data readily accessible to both those who "need-to-know" as well as to others. Security of such data is essential from those who should not have access. Additionally, other aspects of the privacy issue include the use of inaccurate data because of various human errors, such as data input.

Unfortunately, sometimes such incorrect data has the authority of correctness since it is "in the computer." In addition, the fact exists that decisions can be made regarding individuals only using computerized data and not a complete body of information.

Various legislation has been enacted to assist in the privacy of individuals and which have relevance to schools. These include the Privacy Act of 1974 and the Family Educational Rights and Privacy Act (1974). This legislation indicates that individuals have the right to be informed as to the manner in which data are collected and to its use, and have the right to correct erroneous data. Also, data used for one purpose cannot be used for another without consent. More recently, additional legislation has been enacted in response to the illegal access of governmental computers by non-valid users and "computer-hackers" (The Comprehensive Crime Control Act of 1984).

Another major issue of concern deals with the broad issue of computer crime. Computer crime includes: the theft of property, such as the stealing of hardware and software; the theft of data, such as institutional mailing lists used for other purposes; theft of intellectual ownership through copyright infringement, such as the unauthorized duplication of software and documentation (covered by the U.S. Copyright Act of 1978); and the theft of money, such as duplicate check writing, fraud and embezzlement.

A number of security safeguards can be enacted to discourage computer crime. These include the use of a variety of procedures, including the use of computer passwords to secure access to computers and the frequent updating of these passwords, the use of dial-back procedures for on-line access, and the separation of processing responsibilities.

It must be emphasized that the computer facility, however small, represents an investment that should be protected. Security must be taken into account in selecting a location for the facility, and for securing access to and from the facility, such as through the use of card-keys and coded door keys. With the increasing emphasis on personal computers and LAN-based systems there is interest in the physical security of microcomputers. A number of devices are available to deter theft of these computers as well as of terminals which access larger systems. These include:

- *Anchor pads*—A system of adhesive pads and lockable rods attached to a slim steel housing which is bolted to the computer case making removal virtually impossible
- *Cable anti-theft device*—Uses small adhesive pads attached to a flexible cable that is in turn locked to the table top
- *Motion alarms*—Movement of the equipment automatically triggers a piercing alarm
- *Lockable cabinets*—Available in a wide range of styles and prices, from simple storage cabinets to full, lockable workstations
- *Power cord alarm*:—Disconnecting the power cord from this special socket activates an alarm
- *CPU theft covers*—Metal enclosures that secure the CPU and monitor to the table top

From a broader perspective the school can develop standards for use and ethical behavior regarding computer use, covering such topics as copyright infringement, personal use of computers, the taking of personal computers home, and the monitoring of employees' habits, such as data input speed.

Automation: Players, Their Roles and Relationships

School districts are complex organizations requiring a number of interpersonal and informational exchanges to fulfill their mission. Different levels of the organization have very different data processing needs. Tying all of these needs together in a manner that provides accurate information in a timely fashion and at a reasonable cost is a difficult task which requires a great deal of effort on the part those individuals responsible for the automation process.

The district business office needs up-to-date information about the flow of funds for both cash management and to make sure expenditures stay within budgetary constraints or appropriations. The business office also needs an accurate bookkeeping system to keep accounting ledgers, payroll records and information on invoices and payments. This data needs to be

accessible for management control and for both internal and external audits.

The business office also needs an accurate payroll system to ensure that employees receive their pay checks on time, and their benefits are accounted for properly. Other needs that may arise in the operation of a school district business office include information for preparing future years' budgets, data on student enrollments to forecast enrollments (which often determine a district's future revenue), and the data necessary for completing state fiscal and other reporting forms.

Other central office staff may need additional information including data on the number of children in the district requiring, and receiving, special educational services (i.e., special education, compensatory education, and programs for limited English speakers). Information about individual teachers may be critical to the personnel office, so that they can direct teachers with particular skills to schools needing their knowledge, or so that they can recruit teachers with the skills in short supply in the district.

The transportation department can use computers to keep track of school bus maintenance records, and to optimize bus routes to minimize expenditures for home-to-school transportation. The operations and maintenance staff could similarly use computers to schedule maintenance projects and allocate staff to facilities with high demand at particular times of the year.

Finally, one of the biggest users of school district computing resources is often the evaluation unit. This department, which is responsible for the administration and analysis of standardized tests, has very intensive data processing needs related to selecting test samples, distributing and collecting test materials, and analyzing the test results.

At the school level, principals and teachers have different data processing needs. Attendance, course scheduling, library management, and accounting for student activity funds are among the most common administrative tasks that could benefit from automation at the school site. Some of these functions are directly related to district-wide needs also.

For example, both the school site and the district are required to keep accurate attendance data. Development of an automated system that minimizes the difficulty of keeping attendance at the school site, and allows straightforward aggregation of the daily attendance data at the district level would serve both levels of administration.

Other functions may be unique to a particular school. For example, class scheduling requirements could vary from secondary school to secondary school. Junior high and middle schools utilize a variety of scheduling methods, some using the traditional six or seven period day, and others relying on a half-day basic skills class assignment, with individual class instruction for electives.

At the high school level, many schools use two period time blocks for some classes, which could require different scheduling software than schools electing a more traditional approach to class scheduling. The advantage of automated systems is that they allow individual schools

within the same district to make decisions about the type of class schedule they will offer without forcing all schools into one district-established system.

In addition, many principals need assistance in managing individual school budgets. As school-based management programs become more popular, more and more principals will have expanded needs for systems that monitor budget revenues and expenditures. Finally, word processing and desktop publishing programs not only help principals communicate with teachers and the central district, but enable them to put together attractive newsletters to the local community.

Administrative uses of computers also impact teachers. Today many districts use automated systems to print and distribute report cards. Moreover, teachers have found microcomputers to be powerful tools for keeping track of student grades and attendance. Word processing programs are an invaluable assistance to teachers in preparing course materials, and some of the more sophisticated have used desktop publishing programs to improve the appearance of the materials they hand out in class.

Many of these data processing needs overlap, with functions and services in both the central office and at school sites. Obviously, there would be advantageous for the district to consider how these different pieces fit together before beginning to establish automated systems across the district. That way, the computing system will be able to meet the needs of each individual unit, and at the same time provide the ability to share essential information across programs. Developing a network that meets all of these individual needs is not an easy task. It requires careful attention to each of the systems analysis steps outlined in the preceding chapters, and a concerted effort to develop and maintain cooperation among staff at each level. It also requires establishment of a sophisticated networking system and the development of policies to safeguard both the integrity of the data bases and the confidentiality of certain types of data.

School Automation by Size and Type—Scenarios and Options

In the complex world of data processing today, microcomputers have become more powerful than many larger computers were just a few years ago. Moreover, the vast array of computers and peripherals is confusing to even the most sophisticated data processing manager. The concept of a "personal computer" has changed as more and more microcomputer users have established networks that link a number of users together, or link remote users to a larger computer located at a different site. Today, a microcomputer user can access information from other microcomputers, or from a mainframe computer located at a central office.

The advantages of networks for school management should be obvious. For example, a network system would allow school attendance data to be sent to the central office on a daily basis. The central office could aggregate the data from the individual schools, and prepare the required state or

county reports accurately and with a minimum of disruption to the local school staff. Or, school principals could access a fiscal database and get an instant report on remaining budget balances for those funds over which they have control. Similar benefits from a shared data networks would accrue to other financial matters, student achievement data, and information about personnel data throughout the school district.

Advances in computer software and hardware even make it possible for districts that have long relied on large mainframe systems to collect and share data with remote (school or office) sites with a minimum of modifications to existing computers and software. Schools can be linked together with computer cable, or more practically, if there are substantial distances involved, through the use of modems and telephone lines connecting personal computers at school sites with larger host systems at the central office. Moreover, for smaller districts, advances in microcomputer capabilities may enable them to manage all of their data processing needs through a top-line personal computer. Finally, the availability of electronic mail networks can improve communications among school district staff. Often it is difficult for busy school principals to get in touch over the phone with equally busy central office administrators. Yet frequently, all that is needed is an answer to a question that does not require personal contact. The use of electronic mail, which allows people to send "mail" to one another can greatly facilitate most school district communications.

In response to the school reform movement of the 1980s, many districts are starting to implement school-based management programs. In addition to changing the basic authority relationships between the central office and local school sites, school-based management has significant implications for administrative computing. It seems that one outcome of the school based management approach is greater autonomy over the school's budget.

While conceptually, this is an important and straightforward issue, implementation of systems to make local control over larger segments of a district's budget are quite complex. For example, in most school districts today, the purchasing functions are handled by the business office. Most schools fill out purchase orders or requisitions when they want to purchase something, and the central office provides the requested materials. Schools also receive regular reports summarizing their expenditures and indicating the level of available resources for future needs.

While similar systems will be needed under school-based management programs, if local schools have greater authority over budget and spending systems, the role of the central business office may change. Where in the past, the business office may have exercised substantial control over the flow of funds, now its role will be to facilitate school site decisions, and help sites avoid over-spending their available resources.

While the complexities of these changes are substantial, networked computing systems seem to offer a powerful tool to help resolve these issues. It will become more important that school principals be aware, on a daily or weekly basis, of their account balances.

Designing a system that allows this flexibility, within the constraints of existing district resources, will challenge all business offices. The systems approach we outlined above, is one way to analyze these issues and make rational decisions that account for the individual characteristics and specific operational issues in your school district.

One of the most important considerations in designing a computer application to meet district needs is the human element. Unless the staff responsible for using and maintaining the system are "on board" the chances of system failure are substantial. The next section describes a number of important human considerations that you need to keep in mind as you conduct a system analysis and begin implementation of an automated system.

Issues and Strategies for Implementation Success

Throughout this book we have proposed establishing of new ways of doing things — in this case by automating certain functions. The individuals responsible for carrying out the specific tasks that have been automated will only adopt the new methods when they are convinced that the new procedures will help them do their jobs better and more efficiently. Unless you have their participation in the automation process, success is unlikely. Therefore, it is very important that you consider this human element carefully as you conduct a systems analysis and as you plan your implementation strategy. Included among the issues you should consider are:

- User input
- Training
- Long-term support
- Evaluation

User Input

As you design an automated system, it is vital that you seek input from the people who are responsible for the task you are planning to automate. Since these are the people who are currently doing whatever needs to be done, and presumably will continue to be responsible for the same task once the implementation of the automated system is complete, understanding their needs is important to your success. Besides, who, other than these people, will have a better idea of how things can be designed to work better?

It is important to meet with the affected parties, at all levels of the office, to seek input into how the process can be improved. After all, as long as you are modifying the system, why just automate what you are already doing if there is something you can do that will improve the service or make your staff more efficient? It is important to meet with everyone who is part of the proposed system change. Leaving out secretaries or data entry clerks because they have little authority or responsibility is a mistake since they are the people whose participation is most important once the system is "on

line." Moreover, the people responsible for the work at this level often have excellent ideas about how the process can be improved, simplified, or made more efficient.

One strategy that has been successful in a number of locations is to ask each staff member to develop a list of system needs, and to categorize those needs as follows:

- Absolutely essential
- Highly desirable
- Nice to have, but could live without

Once these lists have been developed, it is helpful to have the entire staff meet to discuss their lists and to develop a list of feature priorities. There are three advantages to this process. First, everyone will gain a better understanding of others' responsibilities. Second, a number of good ideas may be proposed that improve everyone's productivity; and third, the process will help ensure that all of the participants "buy-in" to the changes that are likely to come as the new system is installed. The end result of this process is a set of specifications for the automated system that will form an important part of the preliminary analysis described in Chapter 3.

Training

Perhaps the single most important human element in assuring the success of a new automated system is training. This step is often overlooked in the design and installation of new computing systems, yet unless the people responsible for using the system on a day-to-day basis are well versed in its use, you will not be able to benefit from all of the power it offers.

Training is an expensive and long-term process. Individuals will require intensive training in the use of the new system once it is installed. It is important that employees be able to devote their full concentration to the training process. Little will be learned if you try to train your staff at their desks while at the same time expecting them to answer the phone and fulfill their other job responsibilities. Training should take place in a quiet environment, with a skilled trainer in charge.

In addition to ensuring adequate training at the beginning of the process, strong support is also necessary. There are three kinds of support to consider:

- On-site technical support from a vendor or an employee
- On-site assistance from coworkers
- Documentation from manuals, tutorials and on-screen help programs

Once the initial training is complete and your staff begins using the new system, unanticipated problems are sure to arise. These result from workers not retaining all they learned during training, situations not covered in the basic training, or unanticipated complications. To resolve the first and second of these problems, you will need someone on site for the first few days of operation to refresh workers' memories. As for the third, if the problem is related to the system itself, you will have to seek help from the vendor to correct the situation. If the problem is something that was

considered in the system design, but is simply an infrequent occurrence, then you need someone, either on staff or from the vendor, to be available to assist when the problem arises.

Once the system has been operating for some period of time, and the workers have become comfortable with its operation, it is likely that some will be more proficient in its operation than others. These people should be encouraged to help their coworkers improve their skills, and to continue learning about additional features of the system. For example, if you have introduced a word processing program into the office setting, those workers who learn to use the basic system fastest should be encouraged to help their coworkers learn how to prepare documents using the new system. In addition, you can help these people "stretch" their skills by relying on them to figure out how to format more complicated documents, or to learn desktop publishing techniques and thus improve the presentation of your materials.

Finally, you should be sure that each employee has access and knows how to use the documentation for the system. Often, solving a problem is simply a matter of looking up a simple command in the user manual. However, if finding the user manual requires leaving one's desk and searching out a copy, the manual is less likely to be used, and workers are less likely to find ways to solve problems on their own, potentially reducing the unit's productivity.

As this discussion shows, training is an expensive and continual process. However, this expense will pay off in the long run as all of your employees learn how to use the system, get used to helping each other solve problems, and find new and more powerful uses for the software they have been asked to use.

Long-term support

As time goes on, new uses for the system will arise, and modifications may become necessary. It is important that your relationship with the vendor continue so there are minimal losses in productivity. Whether you rely on the vendor to maintain the system, or hire your own staff, it is important to establish a system that both maintains the system hardware and software, and seeks input into ways to continually upgrade and improve the operation of the system.

Moreover, as employees change job responsibilities or leave to take new jobs, you will have to train new employees in the use of the system. Relying on outside vendors can be very expensive if you want them to come to your site, and workshop schedules may not coincide with your staff needs. Therefore, if possible, it is beneficial to have someone on staff who can train new personnel.

Again, it is important that this training take place in an environment removed from the day-to-day responsibilities of the office. This might result in a short-term loss of productivity, but in the long run, it will ensure that new employees are capable of operating the system efficiently and accurately.

Evaluation

No automation system is complete without constant evaluation. You should constantly be seeking answers to questions like: Is the system doing what it is supposed to do? Is it doing, what we really want it to do? Are there other things it can do that would further improve our productivity or efficiency? Seeking the answers to these questions will help ensure the system really is meeting your needs.

APPENDIX 1
Directory of Selected Educational Administrative Software & Systems

ACT 1000 System
Applied Computer Technologies
P.O. Box 1032
113 E. Main Street
Coats, NC 27521; (919) 897-6612
Hardware and System Components: MS-DOS microcomputers, such as Radio Shack 4080 and IBM PS/2 series, with 640k memory, hard disk, and color monitor. Works under a multi-user environment.
Components: A school maintenance management system providing work order control, a preventive maintenance module, inventory system, and energy accountability.
Cost: Approximately $5,000.
Comments: A package specifically geared towards the management of the school maintenance department.

The Administrators
The Software Library
3300 Bass Lake Road, Suite 304
Brooklyn Center, MN 55429; (612) 566-4212; (800) 247-8044
Hardware and System Components: IBM-PC XT, AT or PS/2 series and compatibles; one floppy and 20MB hard disk; 512k, and DOS 3.1 or greater; a color monitor is recommended.
Components: School Accounting; School Paymaster for payroll calculations and check printing; Student Records; Student Daily Attendance; Student Mark Reporting; Student Billing for tuition, fees and activities; Activity Accounting System.
Cost: Inexpensive packages; each component is priced separately.
Comments: Designed to manage school financial information and student records.

Advanced Procurement Systems

9130 Jollyville Road
Austin, TX 78759; (800) 448-0760

Comments: Software for a total package of purchasing applications, including bidder selection and contracting, purchase order production, and purchase history.

APS

Advanced Procurement Systems
9130 Jollyville Road, Suite 355
Austin, TX 78759; (512) 338-0091

Hardware and System Components: IBM and compatible microcomputers in single or multi-user configurations.
Comments: Software comes in four modules to fully automate the purchasing and stock inventory functions. Inventory can be used as a stand alone or integrated with the purchasing modules and can be interfaced with mainframe financial systems. Specifically designed for public jurisdictions.
Cost: $2,500 per module with increases for network configurations.

BUSTOPS

MicroAnalytics, Inc.
2300 Clarendon Boulevard, Arlington, VA 22210 ; (703) 841-0414
Computerized Bus Routing Software

CALM

Speak Softly, Inc.
303 Calvert Avenue
Clinton, SC 29325; (803) 833-5407

Comments: Produces library catalog cards, card pockets, and spine labels; operates on both Apple IIe and IBM PC.

CAMS

Creative Management Systems
400 Riverside Avenue
Jacksonville, FL 32202; (904) 355-2745

Hardware and Systems Components: MS-DOS, PC/XT/AT/386 microcomputers.
Components: CAMS-1 (housekeeping and custodial system); CAMS-3 (equipment and facilities maintenance); CAMS-3 (inventory management a interactive module or stand-alone); CAMS-QA (quality assurance). Newest release is CAMS-SQL, an inventory and facilities system with integrated inventory management.
Cost: CAMS-1 is $6,000; CAMS-3 is $3,500 to $5,000; CAMS-SQL is $6,000 for single user and $9,950 for multi-user system.
Comments: Maintenance and housekeeping management systems. Includes ability to manage equipment, facilities, and custodial maintenance.

.Carter, Pertaine & Company (CPAC)

1500 S. Dairy Ashford, Suite 400
Houston TX 77077; (713) 558-1270

Hardware and System Components: HP3000 complete line of systems; interface of HP PCs and other manufacturer PCs.
Components: Business services, including financial accounting, human resources management, fixed assets, materials and supplies, food services, and tax collection; Student services, including student accounting, scheduling, attendance, instructional materials inventory.
Cost: Dependent on components selected and hardware configuration.
Comments: Provides complete turn-key application and custom modifications; can assist with other office automation applications.

CASTS (Computerized Accounting and Student Terminal Systems)

Unisys
1 Unisys Place
Detroit, MI 48202; (313) 972-7000

Hardware and System Components: Available on the B 1000, A Series and larger systems product lines.
Components: The K-12 Education Student System includes scheduling, grading and transcripts, and attendance; other components include the Finance System, Personnel System, and Warehouse System.
Cost: Based on components selected and hardware configuration.
Comments: Provides a full range of interactive query possibilities and reports; microCASTS provides microcomputer local processing interfaced to a central mainframe system.

CCL STARS (Student Academic Records System)

Century Consultants Ltd.
300 Main Street
Lakewood, NJ 08701; (201) 363-9300

Hardware and System Components: NCR minicomputers and NCR personal computers (IBM compatible); optional mark sense input.
Components: Student scheduling, grade reporting, attendance, academic history/transcripts, progress/deficiency, student discipline, testing, bus maintenance and routing, personnel reporting system; medical records; library circulation control system.
Cost: Depends on modules implemented and type of hardware configuration.
Comments: Interactive modules yet can be implemented separately.

Classroom Information System

Impetus Inc.
458 41st Street
Richmond, CA; (415) 231-0199
Hardware and System Components: MS-DOS computers
Components: Includes grading; skills record keeping; reusable lesson plan development; lesson performance analysis; task-on-time analysis; attendance; report cards; deficiency reporting.
Cost: $495.
Comments: The system is menu-driven.

Columbia—The School System

Columbia Computing Services
978 Industry Drive, #250
Seattle, WA 98188; (800) 663-0544
Hardware and System Components: IBM PC computers with hard disk drives (or compatibles).
Components: Student record management components including registration, enrollment, daily attendance, grade reporting, scheduling, discipline tracking, health records.
Cost: Depends on packages selected and hardware configuration.
Comments: Includes packages for different size schools: The School System; The Small School System; The Elementary School System; and Integrade, a spreadsheet system for grade recording.

Computrition

9121 Oakdale Avenue, #201
Chatsworth, CA 91311; (818)701-5544
Hardware and System Components: IBM PC XT or PS/2 series and compatibles; 40MB to 80MB hard disk; DOS 3.1 or greater recommended.
Cost: The software ranges from $3,000 to $50,000.
Comments: Software which performs food cost management, including inventory control, menu costing, purchasing requirement calculations, and nutrition content analysis. Computrition has software designed to meet the needs of food service operations.

The CO/OP

135 Beaver Street
Waltham, MA 02154; (617) 891-1999
Hardware and System Components: IBM PC and compatibles; some components operate on Apple IIe
Components: Includes packages, such as the following—Bidmaster, to manage the process of bid purchasing; Budget Builder, a school budget development package; Cus/Staff, a tool to calculate custodial staffing needs; Energy Monitor; Enroll, a tool for forecasting school enrollment; Negotiations, calculates costs associated with collective bargaining; Absense

Tracker, personnel information management, leave accrual and absenteeism; Activity Accountant for student activity fund accounting; Fixed Assets Inventory; Grade Reporting, Scheduling, and Attendance; InvenTally for inventory control.
Cost: Inexpensive packages, from $295 and up depending on software component.
Comments: A non-profit educational management organization providing microcomputer software.

CTB MacMillan/McGraw Hill (Data Warehouse)

2500 Garden Road
Monterey, CA 93940; (800) 538-9547
Hardware and System Components: IBM XT, AT or PC2, or Tandy 3000 or compatible; 20-40MB hard disk; 640 RAM; wide-carriage printer such as Okidata 2410 or Tandy DMP-2110.
Components: SCHOOLMASTER student administrative software including student database, scheduling, attendance/intervention, grade reporting, schedule maintenance, transcripts.
Cost: Approximately $5,000 for single or multi-user system
Comments: Provides linked software so that data from other components, such as TESTMATE, can be imported; a specialized version for the elementary school is also available.

Ecotran

21111 Chagrin Boulevard
Beachwood, OH 44122; (216)991-9000
Comments: Computerized system for redistricting and bus routing.

ED+

Software Plus
301 Route 17, North
Rutherford, NJ 07070; (800) 343-6844
Hardware and System Components: Modular school management software for the IBM AS/400, System/36 or PS/2.

Education Logistics

1024 South Avenue West
Missoula, MT 59801; (406)728-0893
Hardware and System Components: IBM-PC compatible computers; also Digital Equipment Corporation VAX processors with PC emulation; also supports Novell and 3COM local area networks and Unix/Xenix multiuser systems. MS-DOS, VMS, and SCO Xenix operating systems.
Components: PTS-II (Pupil Transportation System), Run Building Optimization, Route Coupling Optimization, Stop Optimization, Boundary Planning,

Boundary Optimization, Enrollment Projections, Fleet Maintenance, Field Trip Management, Special Education Transportation Management.
Comments: Student transportation management system.
Cost: Depends on software package(s) selected and district size.

Educational Timesharing System (SASI)

2165 N. Glassell Street
Orange, CA 92665; (714) 768-6000; (800) 888-7274
Hardware and System Components: 16-bit microcomputers, such as an IBM-AT, IBM/PS-2 or compatible; hard-disk system; operates on a LAN; interfaces with mainframes.
Components: K-12 student demographics, student scheduling, grade reporting, course history, period attendance, test scoring; also a comprehensive series of programs for financial and personnel functions.
Cost: Depends on modules acquired and type of configuration; but basic system in the $2,000 - $10,000 range.
Comments: Designed to operate in a school office, but operates effectively in a multi-school operation. Large user base.

Edunet

3561 Valley Drive
Pittsburgh, PA 15234; (412) 835-7720; (800) 292-9979
Hardware and System Components: DEC PDP hardware; and IBM-PC and compatibles.
Components: Budgetary Accounting; Payroll; Personnel Management; Bid Tabulation and Preparation; Budget Preparation; Central Warehouse Inventory; Census; Student On-line Attendance; Student Grade Reporting; Student Scheduling; Transportation Assignment and Recording; Transcript Preparation and Tracking.
Cost: Each component is priced separately; average price is about $1500-$2500 per component for personal computers.
Comments: System is configured to meet the needs of individual schools and school district requirements. System provides both inquiring and extensive report generation. A full service company providing software, training, and support; in addition, other supporting software, such as word processing, is also distributed. Previously known as BECK Computing Services Incorporated.

Eloquent Librarian

Eloquent Systems Inc.
1501 Lonsdale Avenue, #25
North Vancouver, BC, Canada V7M 2J2; (800) 663-8172
Hardware and System Components: IBM-AT, PS/2 or compatible.
Components: Cataloging, circulation and media booking.
Cost: $1,900 for media management module in addition to base module price of $1,200 to $2,900 depending on number of titles.

Filmpath

Alpine Data Inc.
737 S. Townsend Avenue
Montrose, CO 81401; (303) 249-1400
Hardware and System Components: IBM-PC or compatibles.
Components: Cataloging, circulation and media booking.
Cost: $500 to $895 for single entity; $5,000 for a school system site license.
Comments: An audio-visual cataloging and scheduling system which operates on IBM/PC-XT/AT or compatibles. $2,500 for a single site; site license agreements for multiple site installations.

Follette Software Company

809 N. Front Street
McHenry, IL 60050; (800) 323-3397
Hardware and System Components: IBM-PC compatibles and Apple microcomputers. Comments: Software for library automation, including Circulation Plus, Catalog Plus, and Textbook Plus.

HG&A Software

3 Radnor Corporation Center Suite 116
100 Matsonford Road
Radnor, PA 19087; (215) 687-1160
Hardware and System Components: IBM System/36 and AS/400 Systems.
Components: Student records, attendance, grade reporting, discipline, teacher test scoring, scheduling, payroll, personnel, salary negotiations, budgetary accounting, tax accounting, census, bidding/purchasing, fixed assets, and inventory.
Cost: Depends on components acquired and hardware chosen.
Comments: A menu-driven, integrated software package; allows user-defined features; interface with IBM Displaywriter and Query/36 report generator. An IBM Business Partner.

Komputrol

109 W. Jackson Street
Cicero, IN 46034-0500; (317) 984-3533
Hardware and System Components: IBM AS/400, IBM System/36, or IBM PS/2 or compatible operating under MS-DOS.
Components: Include: 1) Budgetary Accounting which includes budget forecasting, appropriations, accounts payable, revenue, purchase order printing, bank reconciliation, investments. 2) Payroll Processing, 3) Personnel Management which includes scattergrams for collective bargaining, personnel classification data, applicant tracking. 4) Fixed Assets Inventory for asset tracking and insurance cost containment, inventory accountability. 5) Utilities Management to track utility costs year-to-year, building-to-building. 6) Student Management System covering scheduling, grade reporting, attendance, discipline, textbook fees, etc. 7) Extra-Curricular

Accounting System for student activity fund accounting.
Cost: Financial Management System ($15,000); Student Management System ($12,000); Extra-Curricular Accounting System ($2,500).
Comments: The firm specializes in the development of software for school corporations. An IBM Partner.

The Leadership Series

Pentamation Education Systems Division
One Bethlehem Plaza
Bethlehem, PA 18018;(215) 691-3616
Hardware and System Components: Digital Equipment Corporation VAX line of computers from the MicroVax unit to the more powerful VAX processors; operates under VMS system software.
Components: Daily and subject attendance; student transcripts; report cards; scheduling; registration; office assistant for office automation applications; warehouse inventory; fixed assets; payroll; personnel; and financial accounting.
Cost: Depends on components and the specific hardware configuration.
Comments: Provides a complete, turn-key system of hardware, software, facilities planning, installation, training, and support; installed and operating in school districts through the U.S. and Canada.

LEAFS (Local Education Agency Financial System)

American Management Systems Inc.
1777 North Kent Street
Arlington, VA 22209; (800) 336-4786; (703) 841-6838
Comments: Financial management system for school districts.

LedgerBase

Brunswick Data Inc.
P.O. Box 6189, Station A
Saint John, NB, Canada E2L 4R6; (506) 633-2990

Library Processes System

919 W. Canadian Street
Vinita, OK 74301; (918) 256-8598
Comments: Software to operate on IBM-PCs and compatibles, the Apple II family, and Radio Shack Model III/IV. Includes Catalog Card Program, Spine/Pocket/Cards Label Program, and AudioVisual Card/Directory Program.

LIBS 100

CLSI Inc.
320 Nevada Street
Newtonville, MA 02160; (617) 965-6310
Comments: A turnkey, minicomputer-based system for library and media center automation.

MacCards

CASPR
20111 Stevens Creek Boulevard, #270
Cupertino, CA 95014; (408) 446-3075
Comments: Library card and label production system for the Apple Macintosh computer.

Mac School

Chancery Software Ltd.
545 108th Street, #6
Bellevue, WA 98004; (800) 937-0016
Hardware and System Components: Apple Macintosh
Components: CSL Scheduling; CSl Attendance; CSL Report Cards and Transcripts; CSL Marks; CSL Library for cataloging and circulation; CSL Health Record and CSC Guidance; District Module for data analysis and statistics; and Fund Accounting.
Cost: Single user version is $3,600; multi-user version is $4,200.
Comments: Integrated and individual school software for systems with up to 4,000 students per building. Multi-site licenses are available.

MacFiscal

Turner Data Systems Inc.
17885 Sky Park North, Suite E
Irvine, CA 92714; (714) 261-5094
Hardware and System Components: Macintosh SE & II Components: fund accounting, including budget development, general ledger, income, expenditures, purchase orders, stores inventory, payroll, fixed assets, and student fees.
Cost: $6,500 to $14,400.
Comments: MacFiscal meets the needs of financial accounting requirements. A modifiable twenty-four digit account number can satisfy district's structure and provide connectivity to all modules.

Media and Equipment Management

Educational Activities Inc.
P.O. Box 392
Freeport, NY 11520; (800) 645-3739
Hardware and System Components: Apple and TRS-80.
Components: cataloging and media booking. Cost: $269.
Comments: Audio visual media booking system. Provides confirmation, shipping lists, management reports, and a report generator capability.

Media Manager/3000

VIS Consultants Inc.
2000 Century Plaza, Suite 400
Columbia, MD 21044 ;(800) 847-2243; (301) 997-1116
Hardware and System Components: HP 3000 family.
Components: Cataloging, circulation and media scheduling and booking.
Cost: Beginning at $3,995.
Comments: An integrated system operating in multi-user environment.

Mediatrack

Dalton Computer Services Inc.
P.O. Box 2469
Dalton, GA 30722; (404) 259-3327
Hardware and System Components: IBM-PC or compatibles.
Components: Cataloging, circulation and media booking.
Cost: From $1,700 to $3286 depending on options.

Melvil

Compel Inc.
5113 27th Avenue
Rockford, IL 61109; (800) 545-0053; (815) 229-8600
Comments: Circulation for tracking books, periodicals, and audio-visual materials; Card Catalog for a menu-driven online catalog. Available for PC-DOS and NETBIOS LANs.

PSI School/300 and Student/3000

Carter-Pertaine Systems Inc.
1500 S. Dairy Ashford, Suite 400
Houston, TX 77077; (713) 558-1270
Hardware and System Components: Hewlett-Packard 3000; a distributed network linking together multiple products and systems.
Components: SCHOOL/3000 consists of budgeting, accounting, personnel, payroll, inventory, purchasing, fixed assets, revenue tracking and school supplies modules; STUDENT/3000 includes student management, general administration, scheduling, attendance, testing, grading, and transcripts modules.
Cost: Dependent on configuration; the starting price for either is $25,000.
Comments: Provides an integrated, menu-driven system. An electronic manual assists in making the system easy to use. Designed to include multi-level security. An additional feature is an office automation component which consists of word processing, electronic mail, time management, decision support graphics, and sophisticated report generation.

Right-on Programs

RIGHT-ON
755 New York Avenue
Huntington, NY 11743; (516) 424-7777

Comments: Inexpensive library/media packages for a variety of applications, including audio visual catalog card production, overdue book control, subscription control, and media center equipment inventory. Various packages available for Apple and IBM and compatible microcomputers.

Roger Creighton Associates

Roger Creighton Associates Inc.
274 Delaware Avenue
Delmar, NY 12054; (518) 439-4991

Hardware and System Components: IB, PS/2 Model 70 or equivalent with 2MB RAM and DOS 4.0; HP Laserjet II, or equivalent.

Components: School Bus Routing System (SBRS) loads, routes, and fleet-schedules buses, prepares drivers directions and maps, and prepares state report. Produces economic output for cost analysis purposes. School Redistricting System (SRS) performs essential redistricting tasks, including development of alternative boundary scenarios and alternative building scenarios. Building loads are computed by grade and compared with room capacities. Ethnic and other student breakdowns are also prepared. Trend forecasts can be computed and subdivision data entered.

Cost: Costs depend upon enrollment and land data. Costs are divided almost equally between software and services, including services for comprehensive data development of street network, house numbering, address guide directory, preparation of computer drawn maps, student file verification, and training.

Comments: Installation services available up to the point of route development. Complete, turnkey development with routes is negotiable. Allow six months for installation.

School-A-Tronic

Star Business Services
Box 3000
Tulsa, OK 74102; (800) 333-3827

Comments: Provides activity fund systems, including account ledgers, receipting, disbursements, budget, purchase orders, monthly reports, and check writing. Operates on IBM, Macintosh, and Apple PCs.

Schoolmaster

Tandy Corporation/Radio Shack
1400 One Tandy Center
Ft. Worth, TX 76102; (817) 390-3011
Hardware and System Components: Radio Shack.
Comments: Integrated software for managing administrator and teacher daily tasks.

SchoolPlus

Infocel
4800 Six Forks Road
Raleigh, NC 27609; (800) 545-2021 Ext. 304
Hardware and System Components: Operates on Prime super minicomputer systems; communications capability from most popular microcomputers to the Prime system.
Components: The student administrative system has a number of modules including: student records management, student grade reporting, student scheduling, attendance, discipline tracking, student locker assignment, and student bus route assignment. The financial management system includes: general ledger, accounts payable, accounts receivable, central receivables, budget preparation, purchasing management, human resources (payroll and personnel), grants management, investment management and financial report writer. SchoolPlus school administration software is modular and integrated.
Cost: Depends on components acquired and hardware configuration.
Comments: Provides a comprehensive, integrated, turn-key package of 20 modules for student administration and financial management and report; a course authoring system is a component.

Secondary Educational Administration System

Ace Software Inc.
6110 Enterprise Parkway
P.O. Box 254
Grove City, OH 43123; (800) 837-2692
Components: Student Information System, including attendance, grading, scheduling, bus routing, and academic history; Financial Accounting, including accounting, general ledger, payroll, personnel, and fixed asset inventory; other components include School Bus Maintenance, Document Management, and Test Scoring.
Cost: Depends on components.
Comments: Complete package of applications directed towards the needs of secondary school districts.

Smarts

Computer Solutions Inc. (CSI)
397 Park Avenue
Orange, NJ 07050; (201) 672-6000
Hardware and System Components: HP 3000
Components: Budgetary accounting including budget preparation, purchase order and check writing, vendor histories, cash receipts, and inventory; and personnel record keeping/payroll including employee attendance, substitute teacher tracking, certification and employee history, user definable earning and deduction types. SMARTS also includes a Student Record Keeping package. Features of this package includes student demographics, attendance, grading and scheduling.
Cost: The package is priced by module, according to the size of the hardware configuration.
Comments: Complete financial accounting for public school districts, Provides on-line documentation.

Software Plus, Inc.

Education Plus Division
Meadows Office Complex 301 Route 17 North
Rutherford, NJ 07070; (800) 343-6844
Hardware and System Components: IBM System/36, AS/Entry, and IBM AS/400.
Components: Student applications include student database, attendance, grades, test scoring, scheduling, special education, and bus scheduling (microTRIPS); Financial applications include budget and finance accounting, receipts, budget preparation, requisitions, payroll, personnel, negotiations, bid requests, fixed assets. State reporting included in financial, student and transportation components.
Cost: Depends on components acquired and hardware choice. Each module priced separately.
Comments: Provides complete range of support, including software installation, training, implementation planning, system modifications, and support. PS/2 compatibles supported as terminals to system. Local software companies market and provide support in several states.

SDS (Specialized Data Systems)

855 W. Prairie Avenue
Wheaton, IL 60187; (312) 462-1264; or (800) 323-1605
Hardware and System Components: Operates on a variety of IBM and IBM compatible personal computers. Networking is included within the software where multiple PCs can work in the same data file.
Components: Student applications, including Student Records, Grade Reporting, Attendance Records, Health Records, and Special Education, Discipline, Tuition; Financial Applications, including Financial Accounting, Budget Financial Processing, Accounts Payable, General Ledger, Payroll, Personnel

Records, Employee Attendance, Fixed Assets, Voter Registration.
Cost: Depends on components and hardware configuration.
Comments: Software allow ability to create local financial and student reports; system is menu-driven and integrated in nature; system documentation is available on-line and also in book format. 800 WATS line and modem support.

Star

Coresoft Corporation
8541 SE68th Street
Mercer Island, WA 98040; (206) 285-3533
Hardware and System Components: PC-based.
Components: Star Tracts which assists in redistricting, demographic distribution, forecasting trends, and planning for new facility location; Star Routing which assists in optimum transportation routing and stops; and Star Fleet which provides fleet maintenance records, parts inventory, operating and performance data on individual vehicles.
Comments: Software to assist in redistricting, student transportation services and routing, and vehicle maintenance.

Student Base

Brunswick Data Inc.
P.O. Box 6189, Station A,
Saint John, NB, Canada E2L 4R6; (506) 633-2990

Sunpac

Sartox Data Systems
10800 Midlothian Turnpike, #149
Richmond, VA 23235; (804) 794-2800
Hardware and System Components: PCs, mini, mainframe and Unix workstations.
Components: Student Scheduling with master schedule builder, grade reporting and on-line comprehensive, multiple-year history, class rank and GPA information, daily and period attendance and census information. Financial system includes budgetary accounting, payroll, personnel, inventory.
Cost: Entire system and module pricing dependent upon type of hardware.
Comments: User defined system that is not hardware specific.

Tek Data

Tek Data Systems
1111 W.Park Avenue
Libertyville, IL 60048; (708)367-8800
Hardware and System Components: IBM PC or AT, or Zenith PC's.
Components: cataloging and media booking.
Cost: $10,000 (hardware and software) for single user; $16,000 for multi-user software; larger muiti-user systems also available.
Comments: Audio visual media booking system. Provides confirmation, shipping lists, management reports, and a report generator capability.

Winnebago Software Company

310 W. Main Street
P.O Box 430
Caledonia, MN 55921; (800) 533-5430; (507) 724-5411
Comments: Provides Apple microcomputer software for library and media center management, including Computer CAT, an on-line computerized replacement for the card catalog, and Library Circulation System.

APPENDIX 2
Directory of Other Software Cited in Text

Note: Unlike most educational administration software, the following software is normally available through second party sources such as software distributors or computer stores. Software packages in this appendix not readily available from local sources include the name and address of the producer or distributor.

BASIS
Publisher: Information Dimensions, Inc.
(5080 Tuttle Crossing Boulevard, Dublin, OH 43017; (614) 761-7300)
An advanced text information management system designed for efficient handling of large text files. Operates on a spectrum of hardware, including IBM and CDC mainframes, and DEC minicomputers.

dBASE II, III, III+ and IV
Publisher: Ashton-Tate
One of the most popular general purpose data base management programs. Operates on most DOS machines.

Designasaurus
Publisher: DesignWare
An interactive program which teaches basic paleontology. Operates on the Apple and IBM. Winner of the 1987 Educational Program of the Year.

Framework
Publisher: Ashton-Tate
An integrated software package which has as components: outlining, word processing, graphics, spreadsheet processing, data base management, and communications.

Harvard Total Project Manager
Publisher: Software Publishing Corporation
A project management software package which provides a variety of components, including a calendar, scheduling, and project charts.

INMAGIC
Publisher: Inmagic Inc.,
(2067 Massachusetts Avenue, Cambridge, MA 02140; (617) 661-8124)
A powerful text indexing/information retrieval package which operates on a series of minicomputers and personal computers.

Lotus 1-2-3
Publisher: Lotus Development Corporation
Combines spreadsheet, database management and graphics. One of the most popular spreadsheet programs on the market today.

MacProject
Publisher: Apple Computer
A visually oriented CPM-based project management package which runs on the Macintosh.

Math Blaster!
Publisher: Davidson & Associates
(3135 Kashiwa Street, Torrance, CA 90505; (800) 556-6141)
An interactive program for teaching basic mathematics skills.

Oregon Trail
Publisher: MECC
A simulation of a pioneer family's trek across the United States frontier.

Paradox
Publisher: Borland International
A popular database management program for DOS microcomputers.

PFS:File and PFS:Report
Publisher: Software Publishing Corporation
An inexpensive and easy to use data base management package. Not as powerful as other DBMs packages. PFS:Report is a companion product to PFS:File.

Rapidfile
Publisher: Ashton-Tate
A file management package which allows the creation and manipulation of single files.

Symphony
Publisher: Lotus Development Corporation
Combines a variety of software components into an integrated package. Components include word processing, spreadsheet, DBMs, and communications.

WORD
Publisher: Microsoft Corporation
A popular, full featured word processing program. Versions are available for both DOS and Macintosh systems.

Wordperfect
Publisher: WordPerfect Corporation
A popular, full featured word processing program. The DOS version is very popular, and a version is also available for Macintosh systems.

WordStar
Publisher: MicroPro International
Another of the most popular word processing packages. Operates on DOS machines.

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Pottstown, PA

Sandra J. McCracken, RSBA
Associate Superintendent, Business
Pinellas County School Board
Clearwater, FL

Chairman, Exhibitors' Advisory Committee
Donald S. Friesz
Vice President, Sales & Marketing
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